

Practical Oral Surgery

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TO

My father, "Heine," long time proponent of the simple, effortless, atraumatic way of doing oral surgery, this book is affectionately dedicated.

Preface

At the outset, this was intended specifically as a textbook for undergraduate dental students. During the writing it soon became evident that it is not possible to separate problems encountered in student days from those that will arise in practice. References are therefore made to "the student" and "the dentist" rather interchangeably. In a sense this has taken the form of a handbook of what the dentist in general practice should know about oral surgery. It is certainly not a reference work, but rather a graduated course of study. The chapters are intended to be read and mastered in sequence, as each is predicated upon the material which precedes it, so that duplication may be avoided to the greatest possible extent.

In the teaching of oral surgery to dental students there is a great temptation to cover everything of interest that might be construed to lie within the field. It is difficult to refrain from discussing in detail rare or unusual entities, particularly if the teacher has had personal experiences therewith. Since the time allotted for the teaching of oral surgery in most dental schools does not permit thorough coverage of the entire field, in this book rare or unusual conditions are omitted or covered very briefly. Reference to any number of excellent works of broader scope will give the student greater detail he may require on occasion.

In the writing of this text, every effort has been made to conserve the time of student and teacher, and to organize the available store of knowledge in such a way that it can be learned readily and remembered easily. Memorization *per se* is not a justifiable goal for any course of study intended to prepare students for the solution of future problems, but a thorough understanding and retention of certain facts are imperative.

A concerted effort has been made to correlate the wealth of knowledge that is commonly referred to as "basic science" with the discussions of clinical problems. Although many treatment methods must remain empirical, an increasing number are being changed as a result of new knowledge derived from research.

For some oral surgical problems many technics of treatment have been reported in the literature. Those which have been selected for inclusion here are most effective and least complicated. One or two good ways of doing a task are offered, in the hope that the student will learn them well and use them often.

Oral surgical care consists of three phases: preoperative, operative, and postoperative. The conscientious dentist will need to know the most important points of each. Yet it cannot be denied that the operation itself is the most appealing aspect of the work involved, and it is hoped that the reader will receive from these

pages the help he needs to make his procedures uniformly successful, enjoyable, and profitable. In the section on technic, emphasis has been placed on simplicity combined with thoroughness. The ideas of saving of time, accomplishment of more work, and avoidance of unnecessary trauma are stressed.

Another feature, in keeping with the trend in most of the dental schools at present, is that exodontia is not divorced from oral surgery. It has always seemed to me that the separation of the teaching of tooth removal technics from training in dissection procedures was illogical. Anyone operating upon a tooth with the intent to remove it is doing dento-alveolar surgery and must be well-grounded in the complete procedure needed to recover the root if it fractures. Further, it is a happy circumstance that the instruments and basic technics used so frequently for removal of teeth and preparation of the mouth for dentures are essentially the same as those needed for removal of a benign tumor or for debriding a shell fragment wound. It is all oral surgery.

The subject of anesthesiology is not covered in this text, as there are several excellent books on the subject now available.

It may disturb the reader to find that details of treatment are not always appended to discussions of the various pathological conditions. All similar technics have been gathered together to conserve time and space.

References at the end of chapters are not intended to constitute a bibliography, but simply denote the source of passages used in the text.

Even though he has studied his didactic material thoroughly, the student cannot hope to be an expert on the first day he works in the clinic. He must practice his technical skills faithfully, while attempting to correlate his basic knowledge with the practical cases under his care. The eighteen to twenty-five half days allotted to clinical oral surgery in most schools is all too little, but should suffice to achieve the goals set forth in the first chapter of this text. If these are mastered, the young dentist will find himself prepared to cope with the majority of oral surgical problems which he will encounter in general practice.

The author wishes to thank sincerely Mr. James H. Rothenberger for his untiring efforts in preparing the photographic material, Miss Barbara Christianson for her excellent drawings and sketches, and Dr. David F. Mitchell for reading and advising on the chapter on Tumors and Tumor-like Conditions.

H. B. Clark, Jr.

Minneapolis, Minnesota

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Definition, Scope, and Objectives of Course of Study in Oral Surgery

Definition. The American Dental Association has defined oral surgery as "that part of dental practice which deals with the diagnosis, the surgical and adjunctive treatment of the diseases, injuries, and defects of the human jaws and associated structures."[1]

Scope. The Association has outlined the scope of the specialty of oral surgery as including the "diagnosis, the surgical and adjunctive treatment of the diseases, injuries, and defects of the human jaws and associated structures within the limits of the professional qualifications and training of the individual practitioner and within the limits of agreements made at the local level by those concerned with the total health care of the patient."

Oral Surgery in General Practice Compared with the Specialty of Oral Surgery. The performance of certain oral surgical procedures in the office of the general practioner of dentistry is not only proper and universally agreed to, but is an essential part of general dental care to the public. There is, unfortunately, little agreement among authorities as to which types of procedures should be done by the man in general practice and which by the specialist.

It would be presumptuous for anyone to set forth a list of the oral surgical tasks that lie within the scope of general practice and another list of those which must be performed by a specialist. Too many factors are involved. Obviously, a good general practitioner will doubtless outperform a poor specialist. It is my feeling that the general practitioner should include in his activities those specific cases for which he is well equipped in skill and facilities, and should refer those about which he feels uneasy or uncertain. The matter of selection of patients will be taken up in the next chapter and the question of referral in the last chapter of the book.

Since the establishment of the American Board of Oral Surgery, it has become somewhat easier to draw a line between oral surgery as a part of general practice and as a specialty. The specialist may be defined as one who is qualified to perform services of an unusual or difficult nature by virtue of special knowledge and skills derived from extended study beyond undergraduate training. The Board has decided that three years of full-time training in graduate school and hospital must be completed before a candidate may come up

[1] Proceedings of special committee of the American Dental Association to study the problems of oral surgery in hospitals (Unpublished.)

for examination before that body. Some states have specialty practice laws which require a definite period of formal training, usually one year, before a man may announce himself as a specialist in any phase of dentistry. In most states, however, at the present time, it is perfectly legal for any dentist licensed in that state to declare that he is a specialist.

It seems safe to predict that with large numbers of dentists now taking intensive formal training, and with an increasing number becoming certified by the American Board of Oral Surgery, it will become more and more difficult to pass as a specialist in oral surgery without extended training and/or the certificate of the Board.

Methods and technics which used to be considered secrets by many of the old school of exodontists and oral surgeons are now being widely taught in the dental schools today. When one realizes the slender margin of advantage held by many of the old time specialists, it is not surprising that an aura of secrecy surrounded their technics and procedures. In recent years, there has been a marked increase in the published material on oral surgical operative procedures, instruments, anesthetic aids, and methods of avoiding complications. It has become clear that there could be no further pretense of private ownership of truth or knowledge.

It might be asked at this point, "What, then, is the excuse for specialists? If the dentist in general practice has access to all this information, and will presumably hasten to acquire and use it, why cannot he become the equal of any specialist in his community?" The answer lies in an appraisal of the amount of time devoted to study of the special field, native talent and skill, special equipment and facilities, amount of trained auxiliary personnel available for the care of patients, and so on. Specialty practice has its advantages as well as disadvantages.

In virtually every community there is plenty of work for all—general practitioner and specialist. Both are needed. It is earnestly hoped that whichever one does the oral surgery will do it to the best of his ability, efficiently, carefully, and with deep concern for the welfare of the patient.

The following objectives or goals of the undergraduate course in oral surgery are given here so that the student may know what is to be included and also the limits beyond which he is not expected to go.

General Objectives. 1. To stimulate the student to recall his basic science knowledge in the light of diseases and morbid processes occurring in and about the oral cavity, particularly those lending themselves to surgical care.

2. To help the student to become familiar with the printed material available on the subject of oral surgery, not only in his textbook but in reference works and in the current literature.

3. To prepare the student to examine intelligently patients with oral surgical disease and to make a diagnosis.

4. To prepare the student to render treatment for uncomplicated surgical disease or to assist with the more complicated, both in his undergraduate training and later as a practitioner.

5. To provide a basis for continuing study as a graduate or post-graduate student, or in the preparation for a teaching career.

6. To train the student in the ability to select cases for his own surgery which lie within the limits of his ability, and to exclude or refer those which lie beyond his easy operating range.

Specific Objectives. Upon completion of his course of study in oral surgery the student should be able to:

1. Administer local anesthesia effectively and safely.
2. Extract teeth in uncomplicated cases and recover root fragments resulting from fracture during removal. This should be done without mutilation of the alveolar process or soft tissues and with minimal hazard of complications, with minimal loss of time, and with minimal effort.
3. Prepare average mouths for the reception of prosthesis in the matter of alveolar bone, muscle attachments, and other soft tissue considerations.
4. Properly perform a biopsy.
5. Care for uncomplicated fractures of the jaws.
6. Care for the commoner and less severe acute infections resulting from dental disease.
7. Carry out the necessary steps for elimination of chronic infections resulting from dental disease.

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Selection of Patients for Surgery

VOCABULARY OF TERMS

Case Report. A compilation of all pertinent information about the patient, the course of the disease, and the results of treatment, prepared in narrative, logical sequence, usually for purposes of publication or presentation to a professional group.

Chart. The collection of paper records on a patient. In the hospital certain specific meanings are frequently implied. This is raw data, confidential, original, and irreplaceable. Certain portions of it are the responsibility of graduate nurses charged with the care of the patient. Unauthorized persons may not write in the chart. However, others may be considered negligent for failure to complete their portion of the record on time and in accordance with required procedure.

Diagnosis. Art or act of recognizing disease. The name of the disease or condition with which a patient is afflicted. *Differential diagnosis* is the process of discriminating the patient's disease from other conditions with which it might be confused. *Tentative diagnosis* is a preliminary name or description of the abnormality, which may be subject to change when further information is secured. *Pathological diagnosis* is the most exact form of identification of a morbid process in terms of microscopic as well as gross changes in structure and physiology. It may be contrasted with *clinical diagnosis*, which is similar in meaning to *tentative diagnosis*. *Final diagnosis* means the fully established name or title of a disease process, after all evidence is in, and often implies the findings at autopsy.

Etiology. The cause of a disease. Predisposing and exciting agents are recognized.

History. The narrative account of the patient's own knowledge of his disease or state of health. It is usually arranged in sections to permit systematic review of all possible sources of information that may be pertinent.

Laboratory Data. Measurements, facts, figures, or other recorded information derived from the use of special examination technics or equipment.

Physical Examination. When shortened to just *examination* this term still carries essentially the same meaning. It means the securing of all possible information about the patient's body and tissues by means of the examiner's senses—sight, touch, hearing, smell, and even, on occasion, taste.

Physical Sign. A manifestation of disease elicited by the examiner's senses.

Prognosis. Forecasting the future course of a disease.

Symptom. A manifestation of disease evident to the patient, subjective in nature.

Sir William Osler has observed that one cannot diagnose a condition unless he first knows of its existence. Therefore it is incumbent upon the dentist to be thoroughly familiar with the disease processes which are likely to occur in and about the oral cavity. Many oral surgical diseases are commonplace, others rare or complex. Whichever situation pertains, it is essential for the operator to know all possible facts about the patient and his disease before instituting treatment. Incomplete or inaccurate information may lead to operative mistakes or even tragedy.

Men with a great deal of experience can sometimes recognize a disease on sight, but this is really dignified guessing and fraught with the possibility of error. It is far better to have firmly fixed in mind a definite order and method of investigation. This can be modified in keeping with the type of case at hand, *i.e.* jaw fracture, impacted tooth, or suspected malignancy. If the examiner always adheres to definite rules for surveying his patient's status, the good habits thus formed will yield dividends in better operative results.

Taking practical considerations into account, three general situations may exist, each calling for somewhat different history and examination procedures.

First, an individual who has been a patient for years may require oral surgery in the office. It is to be assumed that a complete history has been taken at the time of beginning dental care, and the dentist is familiar with any noteworthy features of the patient's health status. All that remains to be done, prior to oral surgery, is a careful deposition of the *chief complaint*, *present illness*, *examination*, and any necessary *laboratory procedures*.

Second, there is the patient who comes to the dentist for the first time as a candidate for oral surgery, in the office. In addition to the above, a review of *past medical history* must be made here which is sufficiently thorough to pick up any significant data that would have a bearing on the procedure.

Third, for surgery in the hospital, a *complete history and physical examination* must be done, usually as a cooperative effort between dentist and physician.

Every time a dentist observes or prepares to treat a patient, he should go through (even if in very brief form) the following steps: (1) History, (2) Examination, and (3) Laboratory aids. The items which come under each of these headings will be considered presently.

During the interviews with the patient in the preoperative phase, when extensive, prolonged, or serious care is to be rendered, these features should be developed in great detail. In the postoperative phase, it may not be necessary to do more than (1) to inquire how the patient is feeling, and follow up any positive leads (history), (2) to inspect the tooth or oral tissues being treated and note the patient's over-all condition (examination), and (3) to review the radiographs briefly, and reflect upon whether further pictures or other laboratory procedures are indicated at the moment (laboratory aids).

This continuing examination and appraisal of the patient is most

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Present Illness (P.I.) This is the whole story, in the patient's own words, of what he knows about his disease. In final form it must be in chronological sequence. It is best to write it in the past tense, whenever possible. If the patient mentions technical terms they are expressed as quotations, so that their veracity may be checked later. The method of drawing information from the patient will vary, depending on whether he is a talkative or taciturn individual and how well he stays on the subject. When time permits, it is well to allow the patient to talk freely. As the examiner listens patiently, he can jot down significant items which will later be rearranged into logical sequence. An added dividend from the interview is the development of a bond between patient and dentist; that is to say they get to know each other. Much will be learned of the patient's temperament, attitudes, prejudices, fears, and general level of intelligence. Many patients achieve a considerable sense of relief upon being able to unburden themselves of their story, and they develop confidence in the examiner as they tell their troubles to an interested listener.

In somewhat the manner of a detective or news reporter the examiner seeks to determine the essentials of any story—who, what, when, where, how, and why. He should pitch his vocabulary at the level of the patient's educational background, using words that will be understood, and avoiding technical phrases. Occasionally it is necessary to take the history in two or more sessions, in which case the complete narrative can be consolidated from the information gained in each. If the patient is unconscious, under the influence of drugs, or is a small child, the history should be taken from one or more relatives or other persons acquainted with the patient's problem. A notation as to the source of the information should be made on the record.

EXAMPLE *Present Illness*

On Tuesday, May 4, 1954, patient visited her dentist because of a toothache in the lower left canine tooth He did some drilling, then sealed in some type of treatment. There was little change in her symptoms until that night, when the pain became more severe, developing a throbbing quality. She phoned her dentist and he suggested cold applications to the face and two aspirins every four hours She was unable to sleep much that night because of the pain. There was also severe earache. The next day, May 5, the pain became more severe and the entire left jaw region began to swell. She was unable to bite on any of the teeth in the lower left jaw. She again visited the dentist He removed the "treatment" from the tooth and said it would probably have to be extracted, but this would have to wait until the swelling went down. He advised her to use hot saline mouthwashes every hour and to take a laxative. For the next two days all the above symptoms became more severe and in addition the swelling extended deeper into the neck and across to the other side. It became impossible for her to swallow solid foods and she could take liquids only with difficulty. On May 7 she consulted her family physician who immediately referred her tothis clinic.

important. The additional information gleaned from repeated contacts should be faithfully recorded as *progress notes* or, in the case of laboratory reports, entered in the appropriate place in the record. If the practitioner develops the attitude of constantly seeking new facts about his patient, he will always be in possession of fresh, new information, and will seldom be unpleasantly surprised.

Needless to say, whenever these brief, interval histories, physical examinations, or laboratory procedures elicit positive findings they must be expanded and elaborated upon to the necessary extent of detail.

Taking the History

It has often been said that the patient will tell his diagnosis if given a chance! History taking is simply an orderly process of extracting raw information from the patient's mind so that it may be refined for the practitioner's use. It is too frequently a neglected phase of dental practice. When omitted the case proceeds in confusion for lack of simple information.

Historical material is best taken down in the form of rough notes as points are picked up, and later reassembled in proper order to give better continuity.

While some prefer to use printed forms with spaces for entry of the various items of history and examination, it is the author's feeling that blank paper more easily permits deposition of the facts in clear narrative form. Printed outlines are usually designed for some ideal or average situation. They frequently provide a small space for a section of the write-up which may require a rather voluminous account for the patient in question. At the same time they may leave a large space for points that need not be developed in detail There is no magic in a prepared outline or questionnaire type of history sheet which will relieve the examiner of the labor of securing historical data.

Remarks from an uncoached patient, in his own words, are exceedingly valuable. If the patient uses technical terms which he has heard from another doctor or dentist, the information is often misleading and inaccurate. It is notoriously difficult to get a good history from the neurotic or hypochondriac who has already been to several practitioners about his complaints

In final form a proper history should contain the following: *Chief Complaint* (C.C.) Sometimes called *Present Complaint* (P.C.). This is the starting point of any history, whether long or short. It usually consists of a list of brief, concise statements indicating why the patient has come to the dentist, given in his own words if characteristic. This is the keynote to the history, but contains few details, as they are developed in the next section.

Example: *Chief Complaint*

1 Severe pain in left jaw
2 Swelling of face and neck.
3 Inability to swallow normally.

gum tissues? Spontaneous bleeding? Orthodontic treatment? Duration? Partial or full dentures? Dates of construction and degree of success achieved? Tooth brushing habits? How many times daily? Dentifrice used? Any mouthwashes? Perborate? When was dentist last seen and what was done? Have teeth ever been *x*-rayed? Full mouth? Bite-wings? Scattered films? When were last *x*-rays taken? Ever bled after tooth extraction? How long? When was it? What measures were required to stop? Any sensitivity to local anesthetics? Adrenalin? Ever had general anesthesia for extractions?

As mentioned earlier, the amount of *past history* that will be required will depend on the particular case and the type of treatment that is contemplated.

Physical Examination (P.E.).

Physical examination, or just *examination* includes everything that the examiner can learn by the use of his own five senses. In addition to abnormalities, negative or normal findings should be briefly noted for future reference. When in doubt it is best to be very complete in the matter of features included. In injury or insurance cases even seemingly drab and unimportant details become essential, such as the length of a laceration in centimeters, the number of millimeters of separation between two displaced teeth, etc.

General Survey. Briefly record patient's appearance and attitude, facial expression, age, race, physique, and state of nutrition. Is patient ambulatory or confined to wheelchair or bed? Presence of pain, restlessness, tremors. Cooperative, or irritable? Note general level of intelligence, apathy, agitation, delirium, stupor, or coma. Note dyspnea, cyanosis, pallor, jaundice, skin rashes, or ankle edema.

Extra-oral Examination. Inspect the patient's face in repose. *Look* for asymmetries, swellings, scars, draining fistulæ, or abnormal pigmentation. Note whether there is mouth breathing, crusting around eyes, nose, mouth, or ears. As patient opens mouth note any lateral deviation of mandible or restriction of movement. Briefly test muscles of facial expression by asking him to smile, wrinkle forehead, and try to whistle. Then *palpate* the face, jaw, and upper neck area. If there is an obvious swelling, examine the adjacent normal areas first, then gently explore the area of interest. A good method of palpation is simultaneous bilateral examination with the finger tips, so that the examiner's tactile perceptions will be sharpened by comparison of one side with the other. As palpation is performed, listen (auscultate) for any audible effects that may be produced. If there is air in the subcutaneous tissues—a frequent occurrence in fractures of the wall of the maxillary sinus wherein the patient has been blowing his nose—a crackling sound known as *crepitus* may be heard. Popping, cracking, or a crunching noise may come from the temporomandibular joint. Upon firm pressure or manipulation of bones, a characteristic sound and palpable feeling may be detected, which is another form of *crepitus,*

This example of a *present illness* is not to be taken as a model to be imitated, for every such account will necessarily be unique. The recorder should not attempt to fit the patient to a predetermined diagnosis or "picture" in any sense of the word. Absolute honesty is essential.

Later in this text, as various oral surgical conditions are being considered, there will be shown the ways in which the *present illness* varies with different diagnostic situations.

Past Medical History (P.M.H.) This portion of the patient's history contributes a rather small part to most oral surgical diagnoses, as a rule. In general dental practice it may be expanded in the specific direction of past *dental* history to good advantage, and the suggested line of questioning in this direction is indicated below.

In the case of a patient who is to be cared for over an extended period of time the *past medical history* should be done, either by the dentist or the family physician, in detail. On the other hand, if it is a patient for whom a single tooth is to be extracted, and no further dental care is contemplated, it is permissible to greatly reduce the questioning under this heading. An absolute minimum would consist of the following:

1. Are you under the care of a physician?
2. Are you taking any form of medicine?
3. Have you ever had any difficulty with previous tooth extractions?
4. Do you bruise easily, or do cuts bleed overly long?
5. Are you sensitive to any drugs or anesthetic agents?
6. Have you ever had rheumatic fever or any form of heart trouble?

For a detailed account of the method of taking the *past medical history* the reader is referred to any standard text on oral diagnosis.

Much controversy has developed over the question of how far a dentist should go in his diagnostic and therapeutic procedures. It is my feeling that a good dentist can never be criticized for doing anything that contributes to a good thorough oral diagnosis, providing his efforts are backed up with insight and understanding, and he is familiar with the technic and purpose of the diagnostic procedure. However, when the area under consideration is manifestly the province of the physician, it is prudent to leave that portion of the examination and diagnosis to him. The dentist, on the other hand, should continually practice the art of securing all possible information about his *own* field. Therefore, while his review of the gastro-intestinal, cardio-respiratory, and genito-urinary systems may be extremely brief, or even omitted, the section on past dental health should be complete in all details. The following questions or points to be noted will be of help in securing a narrative account of the main dental points of interest in the patient's past. Obviously certain portions may be omitted or amplified, depending on the situation.

Have you gone to numerous dentists or stayed with one rather constantly? Dental caries experience? Gum boils? Attacks of trench mouth? What treatment rendered? Other abnormalities of

gum tissues? Spontaneous bleeding? Orthodontic treatment? Duration? Partial or full dentures? Dates of construction and degree of success achieved? Tooth brushing habits? How many times daily? Dentifrice used? Any mouthwashes? Perborate? When was dentist last seen and what was done? Have teeth ever been *x*-rayed? Full mouth? Bite-wings? Scattered films? When were last *x*-rays taken? Ever bled after tooth extraction? How long? When was it? What measures were required to stop? Any sensitivity to local anesthetics? Adrenalin? Ever had general anesthesia for extractions?

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General Survey. Briefly record patient's appearance and attitude, facial expression, age, race, physique, and state of nutrition. Is patient ambulatory or confined to wheelchair or bed? Presence of pain, restlessness, tremors. Cooperative, or irritable? Note general level of intelligence, apathy, agitation, delirium, stupor, or coma. Note dyspnea, cyanosis, pallor, jaundice, skin rashes, or ankle edema.

Extra-oral Examination. Inspect the patient's face in repose. *Look* for asymmetries, swellings, scars, draining fistulæ, or abnormal pigmentation. Note whether there is mouth breathing, crusting around eyes, nose, mouth, or ears. As patient opens mouth note any lateral deviation of mandible or restriction of movement. Briefly test muscles of facial expression by asking him to smile, wrinkle forehead, and try to whistle. Then *palpate* the face, jaw, and upper neck area. If there is an obvious swelling, examine the adjacent normal areas first, then gently explore the area of interest. A good method of palpation is simultaneous bilateral examination with the finger tips, so that the examiner's tactile perceptions will be sharpened by comparison of one side with the other. As palpation is performed, listen (auscultate) for any audible effects that may be produced. If there is air in the subcutaneous tissues—a frequent occurrence in fractures of the wall of the maxillary sinus wherein the patient has been blowing his nose—a crackling sound known as *crepitus* may be heard. Popping, cracking, or a crunching noise may come from the temporomandibular joint. Upon firm pressure or manipulation of bones, a characteristic sound and palpable feeling may be detected, which is another form of *crepitus*,

found in fractures. As the fingers explore the facial structures mental notes should be made of the location, character, size, movability or fixed quality of any masses or derangements found, tenderness, and, in the case of swellings, whether fluctuation is present. If a mass is present, record size in two or three dimensions in centimeters, also the shape, location, consistency, color, whether freely movable or fixed to surrounding tissues, and whether ulcerated. If it is soft, test for fluctuation (fluid wave) by placing the two index

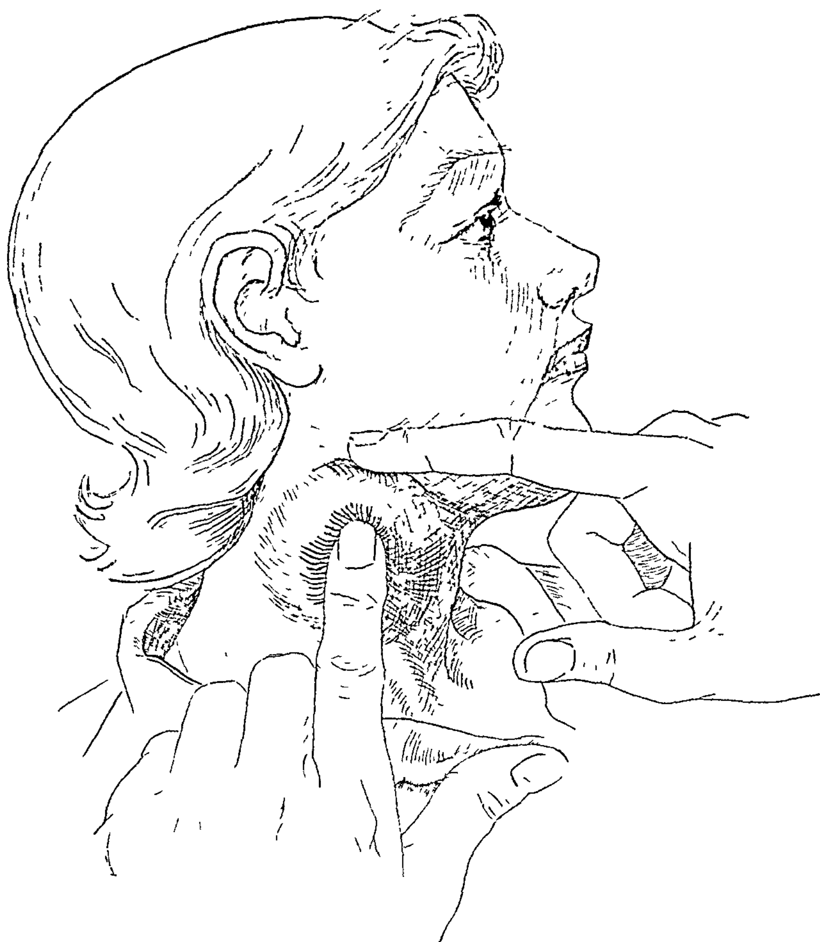


Fig 1 Method of testing for fluctuation (Redrawn from Homans' *Textbook of Surgery*, Charles C Thomas)

fingers on its surface and pressing up and down with one while the other is held still. If an impulse is felt at the tip of the motionless finger, fluctuation is present. Fluctuation indicates the presence of fluid, or, on occasion, a clotted hematoma or mass of fat. Absence of fluctuation does not rule out the presence of fluid, for it may lie deep beneath a fascial barrier. In cases of suspected fracture, the bony landmarks should be carefully explored with light, then deep pressure, to demonstrate any displacements that may be present.

Inspection will often fail to reveal the true position of displaced bony fragments due to superimposed edema or ecchymosis. The latter may make palpation findings somewhat indefinite, but repeated examinations will often serve to help, and in any event the results of treatment should be evaluated by frequent repetitions of this part of the examination.

Intra-oral Examination. All of the examiner's senses are used more or less concurrently in this important part of the examination. Note fetor or any other unusual quality of the breath, degree of dryness of the mouth, and state of oral hygiene. *Inspect* and *palpate*, always in the same sequence, lips, inner surfaces of cheeks, floor of the mouth, tongue, hard and soft palate, tonsils and pharynx. If a positive finding such as a mass, swelling, or laceration is found, observe the features as outlined above. Then proceed with a detailed examination of the marginal and alveolar gingivæ and buccal sulci. Search for redness, edema, ulceration, scars from sinus tracts or actual drainage.

Lastly, the teeth should be appraised in a general way, with notation of those present and erupted in the form of a diagram, thusly:

$$R \; \frac{E\ D\ C\ 1\ :\ 1\ B\ C\ D\ E\ 6}{E\ D\ C\ B\ :\ \quad\ C\ D\ E} \; L$$

This would be a five-year-old child. Note that the designation for temporary teeth is A, B, C, D, and E. When indicated, the teeth should be tested with *percussion*, and with heat and cold or the electric pulp tester. Abnormal mobility, extrusion, abrasion, erosion, and anomalies of shape or position should be recorded.

The foregoing routine should be followed for every patient. If a condition of special interest is present, such as jaw fracture, antra-oral fistula, cellulitis following tooth extraction, etc. the more routine features may be recorded in less detail and more time should be devoted to the major condition.

EXAMPLE: *Examination.*

The patient is a white woman aged thirty-seven years, lying in bed in her home. She appears moderately apprehensive and uncomfortable. Respirations 18, pulse 90, temperature 101.2° F. orally There is a severe swelling of the left lower face from the midline to the left angle, extending down into the neck and slightly past the midline in that region. This entire area is somewhat tender to touch and of hard, brawny consistency. The skin is normal in color. No fluctuation externally Intra-orally, moderate fetor to breath, lips dry, tongue coated. Patient able to open only 1.5 centimeters measuring between incisor teeth From the midline to the lower left second molar area the alveolar mucosa is edematous, red, and pushed out from the mandible both on lingual and facial aspects This swelling is most marked around the cuspid. A sinus tract is seen on the labial of the lateral incisor, draining copious amounts of thick gray pus on slightest pressure Pus is also draining from around the necks of

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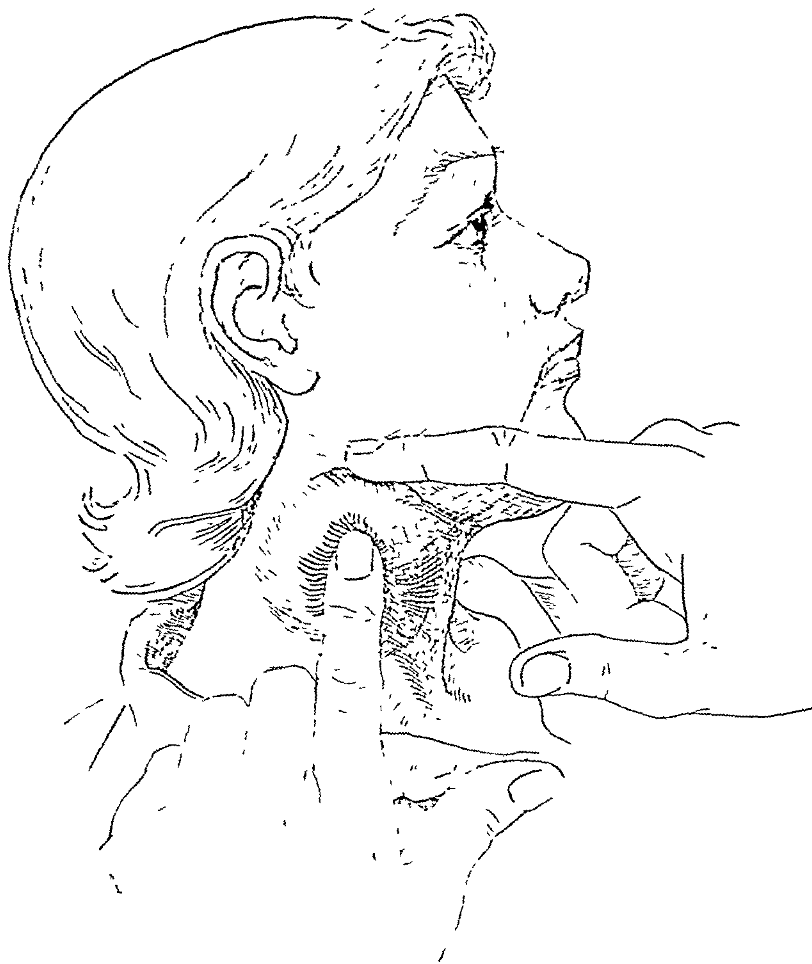


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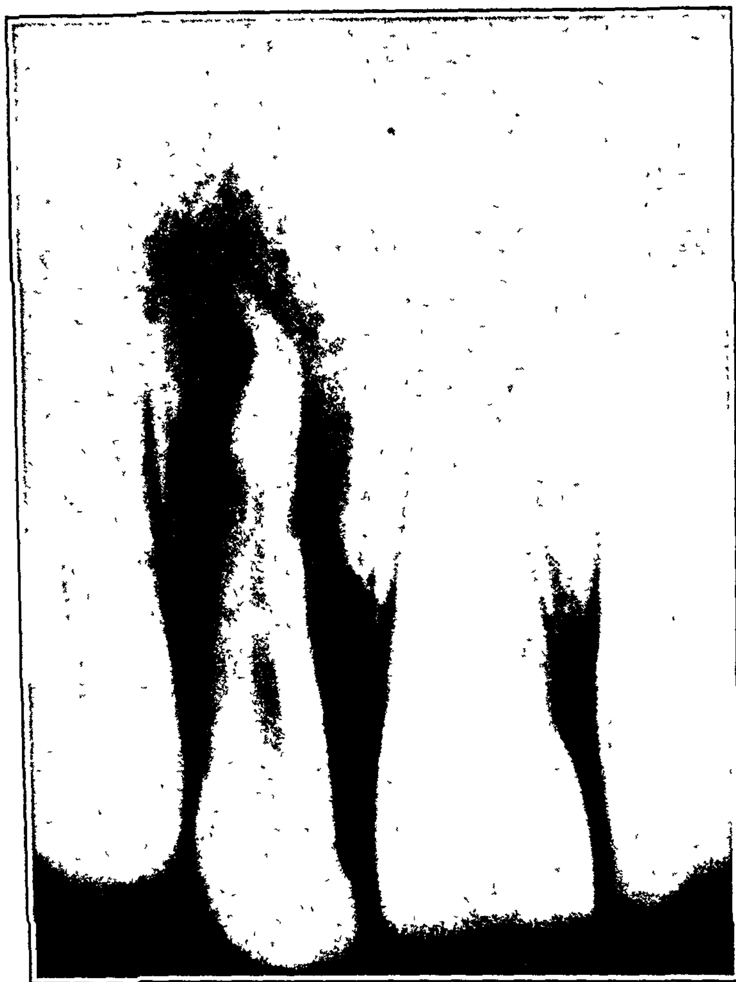


Fig. 2. Dental film, showing periapical pathology.

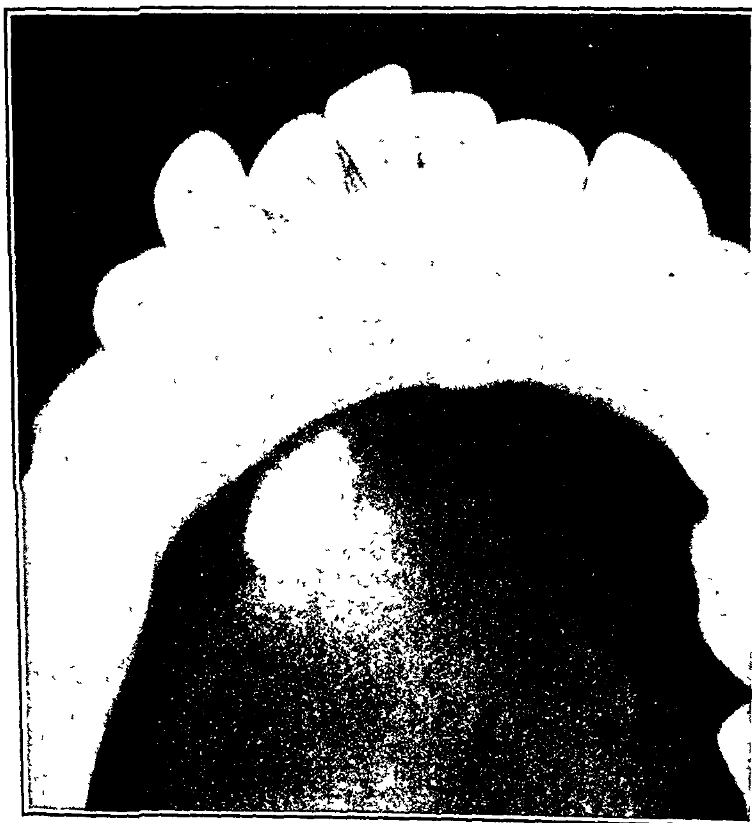


Fig. 3. Occlusal plane film, showing submaxillary calculus.

the cuspid and bicuspid teeth. The second bicuspid is very tender to percussion. The tongue is freely movable, and the palate, buccal parietes, and other structures in the mouth are essentially normal.

Note that in this acount three senses were employed: sight, touch, and smell. Note further that no historical data or laboratory findings are included. From the paragraph one gets a vivid mental picture of the patient's condition at that particular time.

Limits of the Examination Performed by the Dentist. In the above discussion of the examination of the patient by the dentist, it is evident that the emphasis has been on the structures in and about the oral cavity. It is my feeling that examination of the rest of the body, and the rendering of expert judgment on the condition thereof *is not the province of the dentist.* The patient's own physician or some medical specialist selected by the dentist, patient, or family physician should be enlisted for appraisal of the patient's general physical condition.

LABORATORY DATA

Procedures included in this category:

1. Radiographs.
2. Tissue examination (*e.g.* biopsy).
3. Blood count.
4. Other tests of constituents of blood as to coagulability, etc.
5. Urinalysis.
6. Bacteriological smears and cultures.
7. Blood chemistry.
8. Basal metabolism.
9. Electrocardiogram.

Procedures omitted from this category:

1. Temperature.
2. Pulse.
3. Respirations.
4. Blood pressure.
5. Pulp testing.

—as they are parts of the physical examination.

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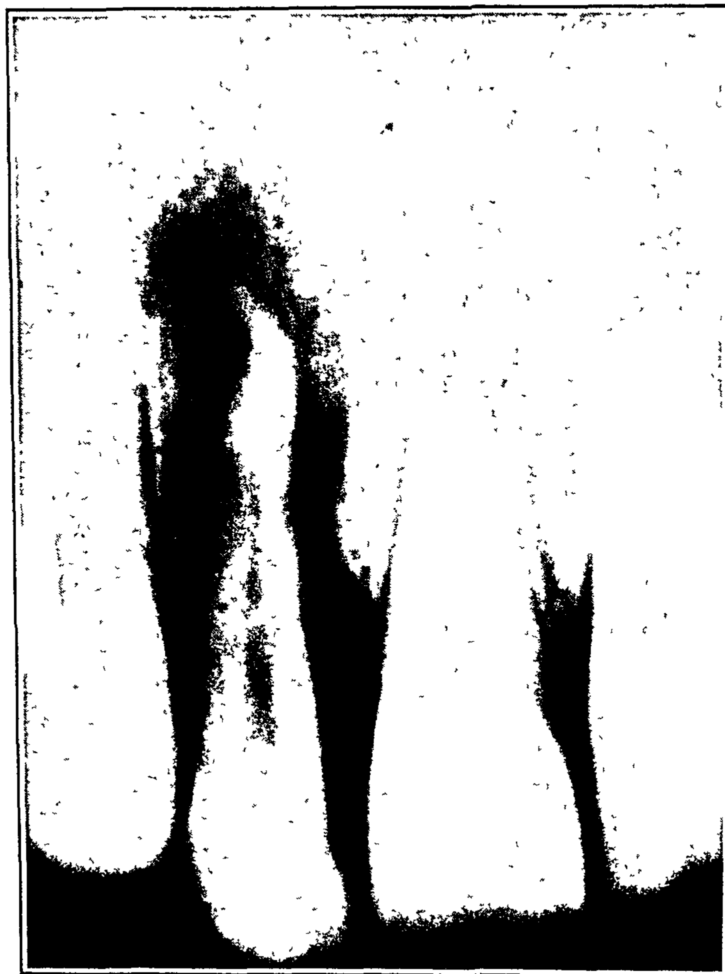


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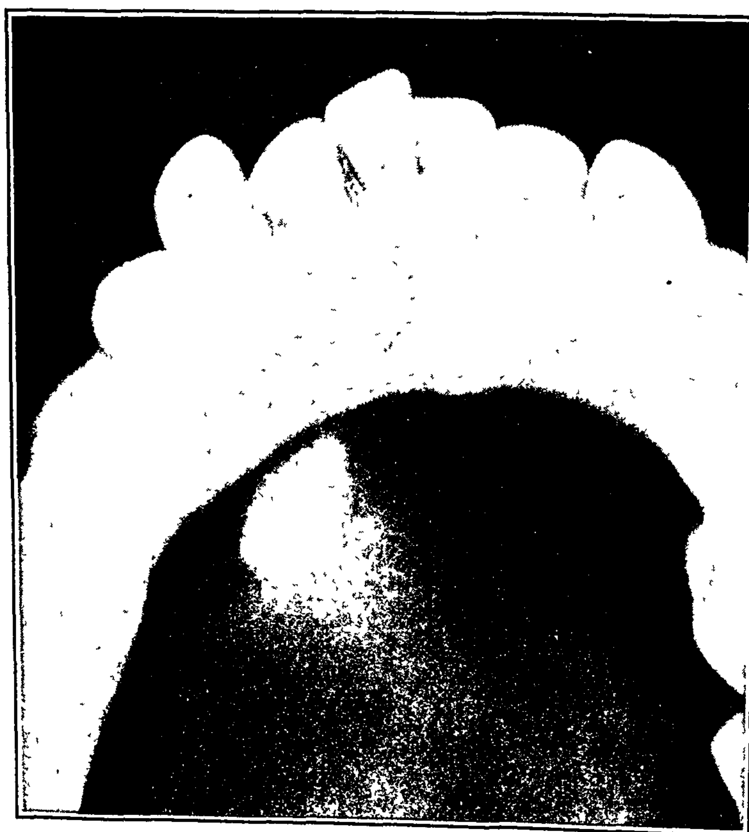


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Total Red Count. This requires considerable labor. It should be ordered if the hemoglobin value is below or much above normal (100 per cent or 16.0 grams.)

Total White Count. This is often just called "white count." It gives a great deal of information and is only moderately laborious. It is also required on all hospital admissions. If this figure is normal



Fig 5 Posteio-anteiioi (P-A) radiogiaph, demonstrating fiactuie

(7,000 to 8,000 per cubic millimeter) it is unlikely the next test will be abnormal.

Differential. This should always be ordered if the total white count is above or below normal. It is quite time consuming.

Complete Blood Count. This is the term used to express all the values of the four tests mentioned above. It does not include bleeding and clotting time, blood calcium, etc.

able in treating fractures or cysts. The *Waters sinus* view is excellent for demonstrating the maxillary sinus and all bones of the middle third of the face. Each of these will be discussed more in detail under the appropriate topic.

2. *Tissue Examination.* The diagnosis of cancer is more important than any other disease with which it might be confused. A positive diagnosis of cancer can be made only under the microscope. Therefore biopsy is imperative for all lesions of the oral cavity

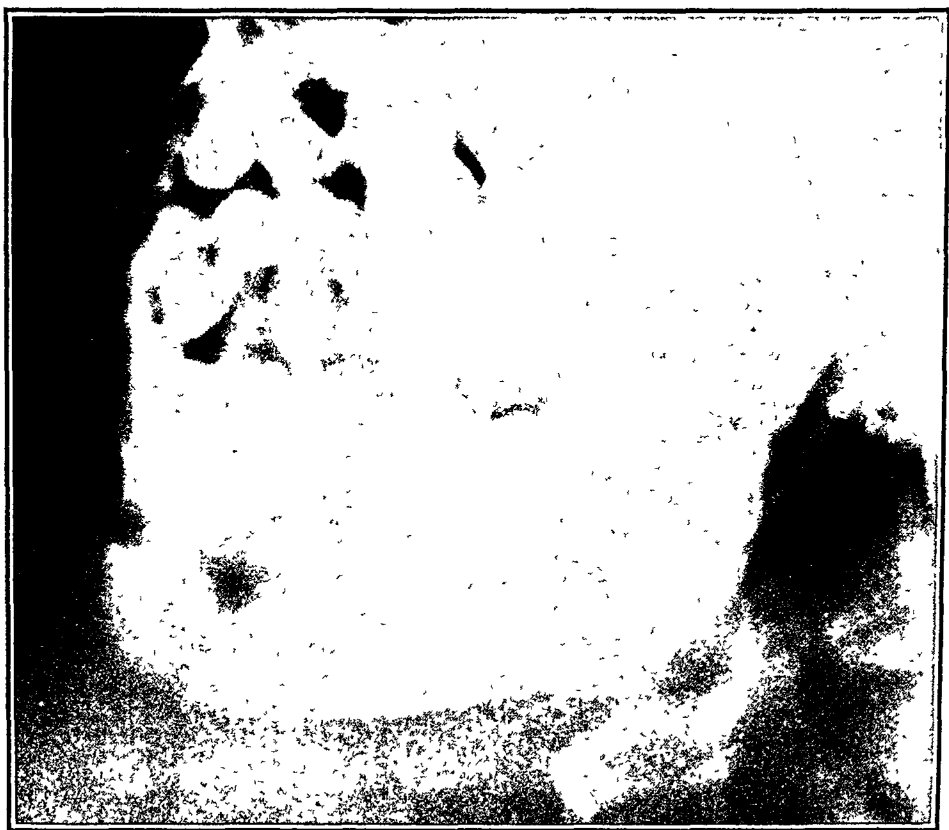


FIG 4 Lateral jaw radiograph, demonstrating fracture.

manifesting hardness, ulceration, or slowness to heal. Remember that early cancer is curable. In addition to deciding the question of cancer, biopsy or tissue examination of whole lesions removed at surgery is necessary to make the final diagnosis on such things as giant cell tumor, ameloblastoma, osteofibroma, etc.

3. *Blood Count.* Every dentist should know the relative cost, amount of labor involved, and the quantity of information obtained from each of the commonly used tests, so that he will freely use the proper ones.

Hemoglobin. This is cheap, easy, and if normal it is likely that the next will be normal.

beyond his required responsibilities if he attempts to make a diagnosis from a single test such as this.

6. *Bacteriological Studies.* Those of prime importance in oral surgery are:

Smear of pus from abscess or draining sinus, especially if the lesion is not responding to treatment. If actinomycosis is suspected, inform the laboratory so they may make proper examination for "sulfur granules."

Culture is necessary to properly identify the organism since most oral infections are mixed. This is time consuming and laborious but necessary in grave infections.

Sensitivity tests are done to determine whether some particular antibiotic will be effective in inhibiting the growth of the organism recovered from the patient's body.

Blood culture is done when intermittent fever, chills, or a severe infection are present. Bacteria are often isolated in pure culture.

7. *Blood chemistry* is seldom required in dental or oral surgical problems. Those procedures occasionally needed are sugar, calcium, phosphatase, uric acid, urea, creatinine, non-protein nitrogen, chlorides, alkaline reserve, etc. See chapter on Medical Conditions of Importance in Oral Surgery (p. 35) for indications for the various tests.

8. *Basal Metabolism.* This would not be ordered by a dentist, as it is only part of a total examination for thyroid disease or other metabolic disorders.

9. *Electrocardiogram* would likewise not be ordered by a dentist as the interpretation must be done by a cardiologist. It is of prime interest in coronary artery disease but too often fails to reveal the desired prognostic data.

Suggestions for Use of Laboratory Aids: 1. Remember that when a test is ordered somebody is going to have to do *work* and someone is going to have to *pay*.

2. Direct physical examination should *always* be done; laboratory work is *sometimes* done.

3. Dependence only on laboratory data and omission of a direct examination of the parts of the patient under consideration constitute laziness and invite serious errors.

4. Laboratory work introduces additional links in the chain of evidence, with chances for error, mix-up of report slips—all kinds of human mistakes.

5. Laboratory procedures should be used to *confirm* or objectively *measure* items picked up on history and examination.

6. The most helpful tests should be used freely: radiographs, biopsy, total white count—and no test ordered without a specific purpose.

Making the Diagnosis

When the history, physical findings, and laboratory data, plus the results of a medical survey when indicated, are gathered together,

4. *Other Blood Tests to Determine its Physiological Properties. Bleeding and Coagulation (Clotting) Time.* This is easily done but not too reliable in picking up those who will bleed excessively after surgery.

Clot Retraction Time, Platelet Count, Tourniquet Test, and Prothrombin Time. These should all be done if the first test is unduly prolonged.

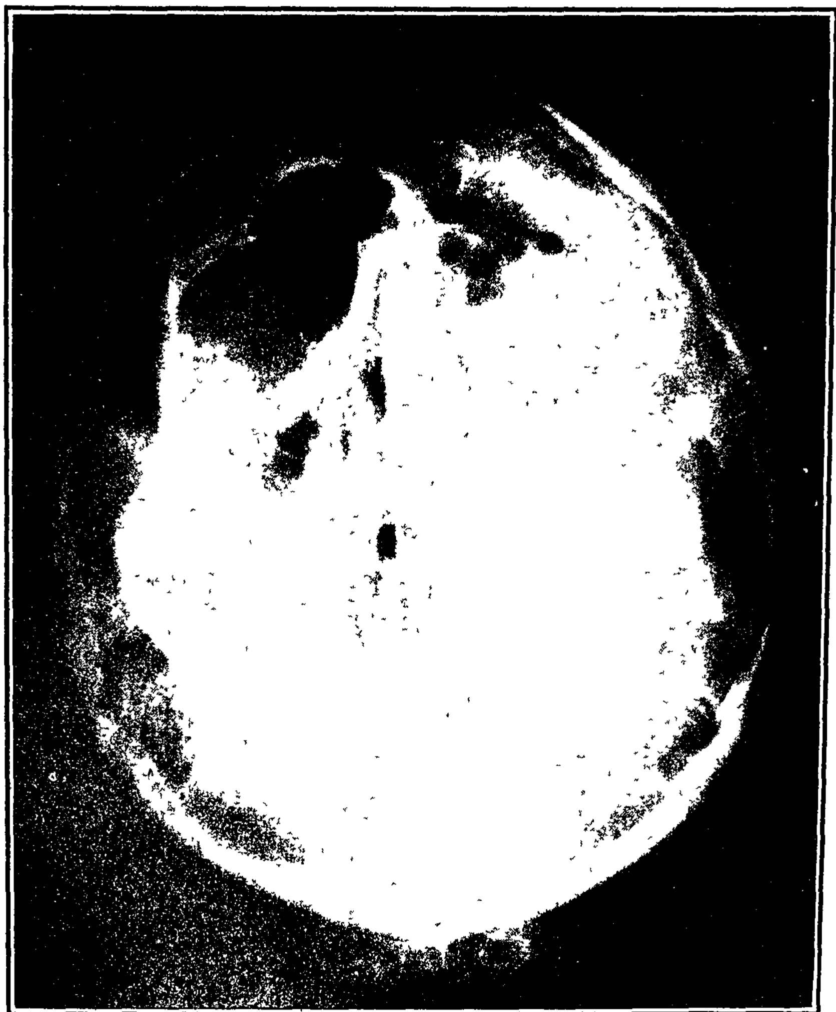


FIG 6 Waters sinus view, revealing fracture of malar bone with hemorrhage into antrum

Wassermann Test (also Kahn, Kline, and Hinton). This is done to detect syphilis. It is not infallible but is highly diagnostic. This should be part of any complete study of a patient in the hospital.

5. *Urinalysis.* Seven items are customarily reported. Most important are albumin and sugar, suggesting at once kidney disease or diabetes respectively. Further medical opinion is imperative if these pilot tests are positive. The dentist is inviting ridicule and going

beyond his required responsibilities if he attempts to make a diagnosis from a single test such as this.

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Making the Diagnosis

When the history, physical findings, and laboratory data, plus the results of a medical survey when indicated, are gathered together,

they are reviewed as raw data from which a diagnosis will be made. A list is then made of all conditions which could logically fit the patient's findings. In obscure cases the list should be made as long as necessary to include all possibilities. This might be compared to a "list of suspects" made up by the police department in an effort to learn which criminal has committed a crime.

Differential Diagnosis. The list is then reviewed and items thoughtfully crossed off when, in the considered judgment of the clinician, they can logically be excluded on the basis of the evidence at hand. In this manner the correct, or at least the best possible diagnosis is determined, by the process of exclusion. This then becomes the *working diagnosis* or, if borne out by further developments, the *final diagnosis.*

It must be recognized that a patient will often be found to have multiple diagnoses, but as this is a treatise on oral surgery, it will be assumed that usually there will be a single major diagnosis.

Indications for the Extraction of Erupted Teeth

Inasmuch as the great bulk of oral surgery as practiced in the dental office is concerned with the removal of teeth and the performance of other necessary associated surgical tasks, it is proper that the various indications for removal should be considered here.

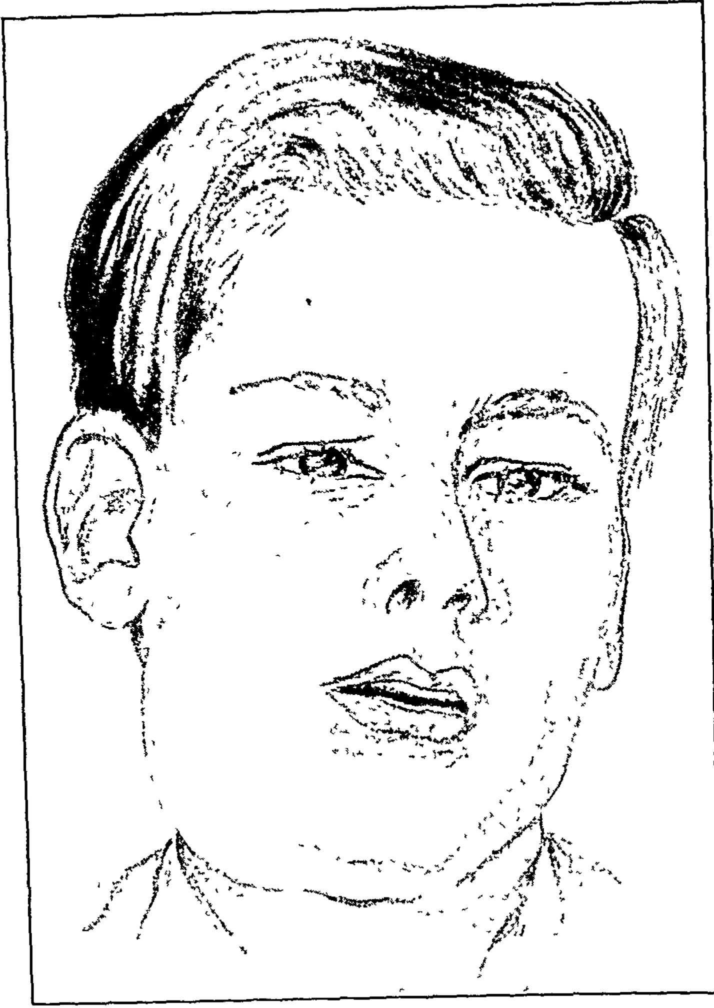
Blair and Ivy have summarized these in the following manner

1. The ravages of dental caries that are beyond repair.
2. Diseases of the alveolar process: *viz,* tumors, pyorrhea alveolaris, alveolar abscess, etc.
3. Irregular position of the teeth. This will include cases which require removal of the teeth preparatory to correction of deformity of the jaw bone.
4. Impaction of the teeth.
5. Accidents to the teeth or their surrounding structures.[1]

It is to be presumed that after the dentist has completed the history, examination, laboratory studies including *x*-rays, and made the diagnosis, that he will also have worked out the complete plan of treatment which he intends to present to the patient. When his recommendations can be defended by sound logic and when all possibilities have been well thought out, it is very probable that the patient will, in the end, accept his judgment.

The practitioner may have honest doubts about whether any of the above-listed indications are sufficiently compelling to demand the sacrifice of a member of the masticatory apparatus. All of the evidence must be carefully weighed before he makes his final decision about which teeth should be extracted. When there are two or more possible plans of treatment, any of which could be justified on the basis of good practice, the alternatives should be presented to the patient with the final decision being left to him. Regrettably it must be conceded that the question of costs enters

[1] Blair, V P. and Ivy, R. H . *Essentials of Oral Surgery,* 4th ed , St Louis, C V Mosby Co , p 257, 1951.



A



FIG. 7. Infection of cheek and jaw resulting from pericoronitis involving impacted lower third molar (*A*, Redrawn from Ciba Clinical Symposia, May-June, 1953.)

into the matter but it is only fair to permit the patient to weigh the various plans against his financial resources and to make the final decision.

Occasionally a patient presents himself to a dentist with a considerable number of his original teeth still present and in a remarkably good state of health, and declares that he wishes to have all of them extracted. In keeping with reason number 2 (p. 34) regarding bizarre attitudes of some patients, it would be recommended that the dentist simply refuse to comply with the request.



Fig. 8. Unrestorable caries of impacted tooth.

Indications for the Removal of Impacted and Unerupted Teeth

It is the author's conviction that, unless definite plans have been made to assist the tooth to erupt and become functional, *every unerupted or impacted tooth in an adult should be recommended for removal.* The only exceptions to this blanket recommendation are those conditions which are contraindications to any oral surgical procedure, and which are mentioned later in this chapter.

Since the removal of an impacted tooth is an important matter to both patient and operator it is necessary for the subject to understand thoroughly the reasons for removal, the possible consequences of not having the tooth removed, and the sequellæ which may follow removal. For this educational purpose an information leaflet on the subject has been prepared which is given to all patients for whom removal of an impacted tooth has been recommended. The contents of this leaflet are given here in full as they cover the subject quite thoroughly.

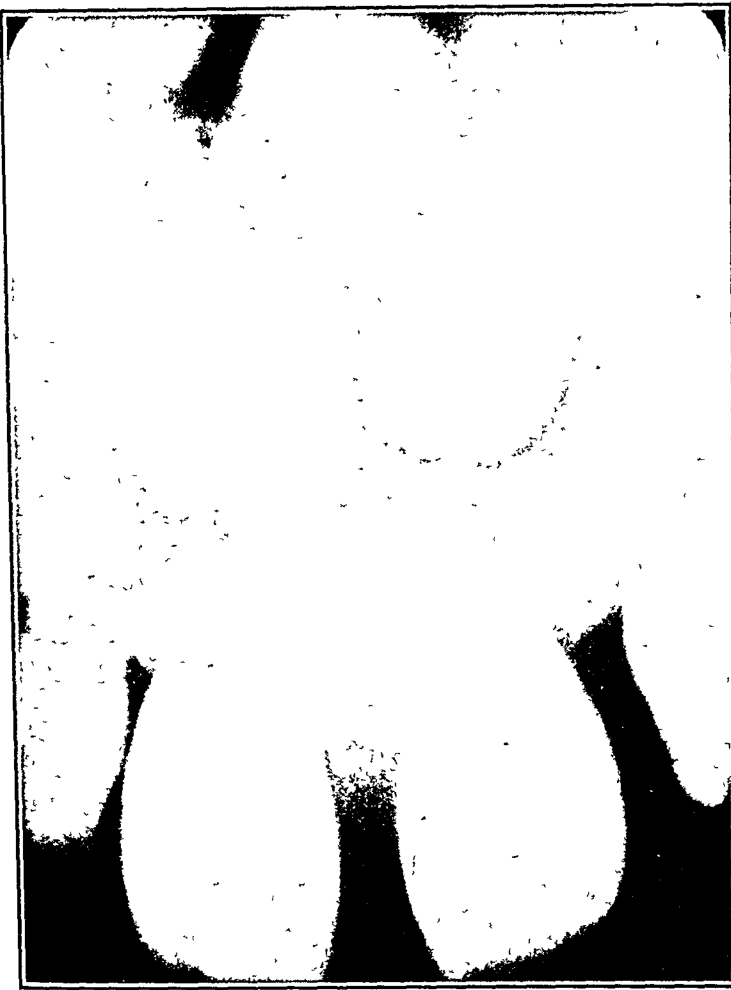


Fig. 9. Resorption of roots of central incisors by impacted upper cuspids.



Fig. 10 Dentigerous cyst forming around crown of impacted lower third molar. (Dr D. E. Brannin, J Oklahoma Dent Assn.)

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GENERAL INFORMATION REGARDING REMOVAL OF IMPACTED TEETH

What is an Impacted Tooth? All teeth are formed deep within the jaw bones. As the root develops most teeth travel toward their future place in the dental arch. This movement is called eruption. If a tooth travels in the wrong direction, or is blocked by another tooth or by dense bone it is said to be impacted or unerupted.

What Harm Do Impacted Teeth Do? Since it is not normal for a tooth to remain beneath the surface after the age of eighteen or twenty-one years, it is easy to understand why difficulties develop.

Whenever saliva can reach the crown—and this may happen even though the impacted tooth cannot be seen in the mouth—decay may occur just as in ordinary teeth. There is no way to fill such cavities and severe toothache finally results.

Likewise, the germs in the saliva may cause pericoronitis, an infection *around* the crown of the tooth. This infection may spread to the cheek, throat, or neck, with severe pain, stiffness of the jaws, and general bodily illness.

As impacted teeth press against other good teeth they injure their roots or push these teeth out of position.

Sometimes a large cyst forms around the crown of an impacted tooth with the destruction of much bone and damage to other teeth in the region.

Why Should Impacted Teeth Be Removed Unless They Cause Trouble? While it is true that not all impacted teeth cause the complications that have been described, no one can tell by an *x*-ray picture which ones are going to give difficulty or when. Trouble usually comes unexpectedly and at inconvenient times. Older individuals do not stand the operation for removal as well as younger people, and the operation is more difficult with advancing age. For these reasons, at this clinic all adults with impacted teeth are advised to have them removed. The only exceptions are certain people with some serious medical disease, or cases where the oral surgeon feels the patient does not throughly understand the purpose and details of the treatment.

Sometimes it is advised that unerupted teeth be removed for children. These decisions are often made by men well-trained in Dentistry for Children or in Orthodontics. Children sometimes have extra (supernumerary) teeth for which removal may be advised to permit normal teeth to erupt properly.

If a patient with an impacted tooth waits until it causes trouble, he will first have to be treated for the infection or other complication before the operation for removal can be done. This means additional loss of time and expense as well as some added risk.

What is it Like, to Have an Impacted Tooth Removed? Many ordinary teeth can be extracted simply by grasping with a forceps and manipulating carefully from the socket. This is, of course, not

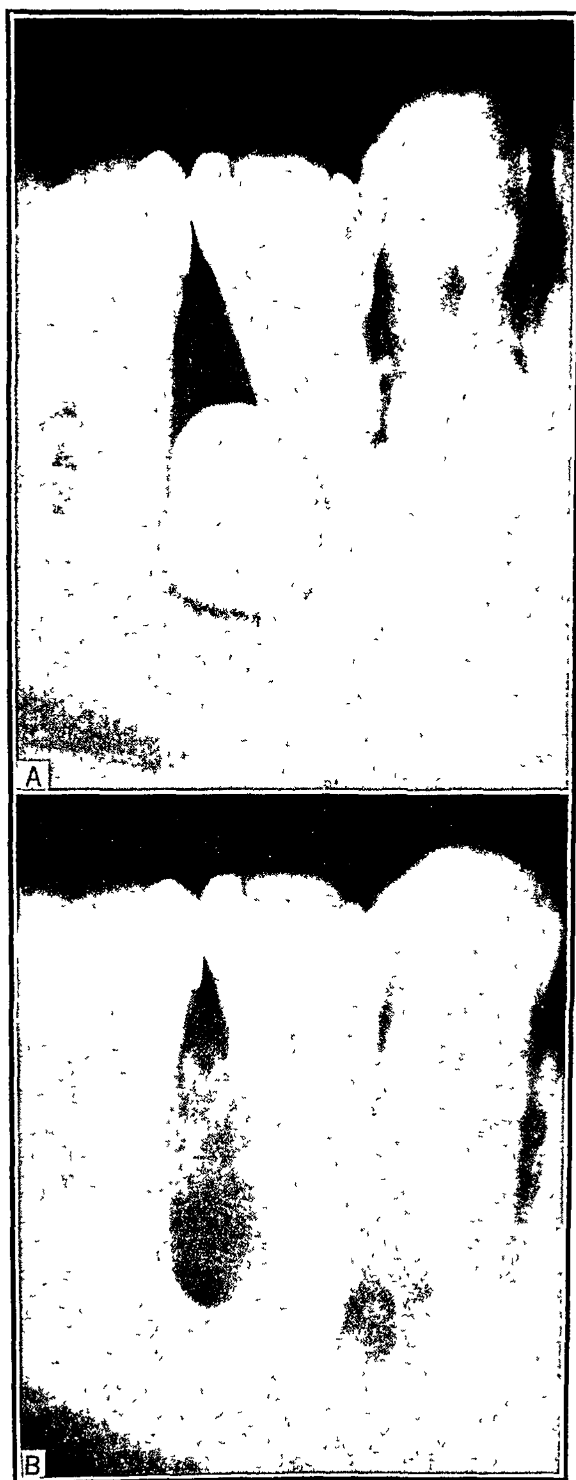


FIG 11 Supernumerary bicuspids *A*, Before, and *B*, immediately after removal

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possible with impacted teeth since they are partially or completely beneath the surface.

We consider the removal of an impacted tooth an operation in every sense of the word. This is not said to frighten the prospective patient, but to give better understanding about certain features regarding the cost, careful preparations, selection of operators, and the need for good aftercare.

In this clinic local anesthesia is usually selected, for there is less bleeding, the operator can work carefully and without haste, and there is less physiological disturbance to the patient than with general anesthesia. However, some cases can be done very satisfactorily while the patient is under general anesthesia. This must be decided by the oral surgeon in charge.

The actual removal of the tooth is done in keeping with surgical principles, with meticulously sterile instruments, good light, a dry operative field, and gentle handling of the soft tissues and bone. Depending on the difficulty of the procedure, it may last for ten to sixty minutes. The wound will be closed with silk stitches. Careful printed instructions for home care will be furnished.

Are There Any Complications? Any operation carries some risk. This is reduced by preoperative appraisal of your physical condition, by careful preparation of instruments and all facilities, and by the skill of the operator.

The wound remaining after an impacted tooth is removed is a large one and healing may be delayed because the body is unable to build in normal tissue as quickly as with a small wound. Fortunately in the upper jaw healing usually proceeds uneventfully. In the lower jaw, however, about three-fourths of the impacted tooth sockets will heal promptly, while about one-fourth will take longer and need some type of dressing every few days. For this reason it is not wise for patients who have had this operation to leave at once on a long trip or be where they could not secure good care by a dentist.

There is often some amount of bleeding afterward but this will usually be slight and will stop by itself after a few hours. Instructions will be given that will tell what to do if more serious bleeding should occur.

Lower impacted teeth often rest on the main nerve to the lower jaw. Sometimes, in spite of all precautions, this nerve is bruised, slightly torn, or even cut in two. The result will be numbness of the lower lip, chin, and all the teeth on that side. This effect does not last more than a few weeks in most cases, improving as the nerve repairs itself and regenerates. Very rarely it may last as long as two years.

Upper impacted third molars lie against the wall of the maxillary sinus or antrum The oral surgeon will use great care to see that no unnecessary injury occurs to this structure, but occasionally the thin wall of bone cracks slightly and blood seeps into this sinus. In such event the patient will notice the presence of blood in the nose.

As a rule, with the use of penicillin or some other antibiotic, this clears up promptly.

All patients about to have impacted teeth removed should understand that adjacent teeth may have been weakened or otherwise injured by the presence of the impacted tooth. This injury may not become apparent until the impacted tooth is removed. Adjacent teeth must therefore be considered on probation for three to six months after the impacted tooth has been taken out.

In consenting to have their impacted teeth removed all patients should indicate they clearly understand the risks that have been described.

* * * * *

It has been our experience that virtually no patients will decide against removal even though the possibilities of adverse developments have been explained to them.

Since removal of impacted teeth is an elective operation there is no valid reason why it should be attempted by inexperienced, inadequately trained, or improperly equipped operators. Removal of these teeth equals in difficulty tonsillectomy, appendectomy, mastoidectomy, cataract, radical antrum, or submucous resection operations.

The operation for removal of an impacted tooth gives a precise index of the ability of the operator. It is invariably unpleasant for the patient, even under favorable circumstances. Many people who have had impacted teeth removed in a two- or three-hour operation say they would rather have a baby, would never have gone through it if they had known what it would be like, and will never go back to the dentist who submitted them to the experience.

In view of all these circumstances it is the considered judgment of most open-minded dentists that the environment of the general practitioner's office is not usually suitable for such procedures. However, if the general practitioner so trains and equips himself that he can render the same level of care as the oral surgeon he should be able to handle these conditions nicely.

Selection of Patients for Surgery

The dentist is never obligated to operate. It is deplorable to permit the patient to order an operation done against the dentist's better judgment or to dictate what anesthetic or technic is to be used.

The operator's successes or "batting average" will be high in proportion to the care with which he selects his cases for surgery. The best guide is whether, from all aspects, the task appears easy, inviting, and well within the scope of the operator's range.

With the *working diagnosis* before him the dentist is in a position to answer the following questions:

1. Does the patient need treatment?
2. Is the indicated treatment surgical or nonsurgical?
3. Will the contemplated treatment do more harm than good?
4. Am I the proper person to render the treatment?

It is highly desirable to defer surgical treatment until at least the second visit. This permits careful arrangement and thoughtful consideration of all the facts. Laboratory reports will be available and radiographs dried and mounted for proper study. The dentist is thus able to form a deliberate judgment that will represent his best thought regarding the patient's needs.

The proposed treatment should be carefully explained to the patient or, in the case of minors, to a parent. The amount of disability, loss of time from work or school, and total cost should be explained. At this point any of the following situations may be apparent, which would lead the practitioner to exclude this patient from his personal list of operations:

1. Strong evidence of lack of patient's confidence in the dentist to do the particular task at hand.
2. Bizarre personality or attitude of patient, indicating improper understanding of the purpose of the operation.
3. Feeling of inadequacy on the part of the operator for the particular procedure to be done.
4. Lack of some essential facility or piece of equipment.
5. An operation which the local population and professional colleagues in the community would unanimously deem beyond the scope of one's ability.
6. Medicolegal contraindications.

Further discussion on this aspect of the dentist-patient relationship will be found in the section on Mental Diseases (p. 47) and in Chapter 16 on the Art of Practice, (p. 367).

On examination the dentist may have uncovered something that constitutes an objective contraindication to surgery:

1. An absolute contraindication, such as inoperable carcinoma of the tongue.
2. A contraindication until some feature of the patient's physical condition has been compensated for or more thoroughly studied. An example would be valvular disease of the heart.

When all of these considerations have been taken into account, and all decisions and explanations completed, plans for the operation may be made.

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3

Medical Conditions of Importance in Oral Surgery

THE borderline between medicine and dentistry is not always sharply defined. Some dentists have been criticized for attempting to practice medicine by extending the range of their activities into fields not commonly thought of as dental. However, a distinction should be made between practicing medicine and knowing about it. The dental license imposes no limitations on the amount of knowledge which a dentist may secure for his own protection and for better dental care of his patients.

Whenever a dentist is in doubt about the physical status of a patient he should enlist the aid of a physician through consultation or referral. Physicians react favorably to this gesture of interprofessional liaison and will develop the habit of calling upon the dentist for decisions lying within his field.

Some systemic disorders constitute an absolute and some a relative contraindication to surgery. The dentist should always keep in mind the maxim "first of all, do no harm."

Only those medical conditions are discussed in this chapter which have a rather clear-cut relationship to dentistry and oral surgery.

SYSTEMIC INFECTIONS RELATED TO ORAL SEPSIS

BACTEREMIA*

It is now well established that transient bacteremias may be found frequently after tooth extraction. The percentage rate of occurrence has been reported as 16.1 by Northrop,[1] 38.2 by Rhoads *et al.*,[2] 46 by Merril *et al.*,[3] and 82.7 by Pressman and Bender.[4] The number of positive blood cultures is considerably higher when samples are taken immediately than when obtained ten minutes after surgery. While no serious harm usually results from this bacteremia in the normal subject, patients with valvular disease of the heart may develop subacute bacterial endocarditis as a consequence. These conditions are discussed later in the chapter. It is the overwhelming opinion of authorities that every effort should be made to prevent this grave complication.

Prevention By Antibiotics. Varying degrees of success have been reported in reducing, by antibiotic therapy, the number of positive

* The material in this section is from WELCH, H. *Principles and Practice of Antibiotic Therapy*, New York, Medical Encyclopedia, Inc, 1954, and is used by courtesy of the publishers.

blood cultures following tooth removal. Northrop[1] found only 1 positive culture in 281 samples taken ten minutes after surgery when penicillin protection was given. By the administration of parenteral penicillin and streptomycin Pressman and Bender[4] reduced the number of positive cultures to 26.4 per cent in samples taken immediately and to 11.7 per cent in those taken after ten minutes. It is evident from these reports that bacteremias can still occur even though antibiotic protection is afforded, but the presumption remains that bacterial endocarditis is less likely to occur.

In 1950 the American Council on Rheumatic Fever of the American Heart Association[5] recommended as a minimum 300,000 units of aqueous penicillin solution intramuscularly thirty to sixty minutes before surgery and 300,000 units of procaine penicillin in oil at the same time, in a different site. Interestingly enough, antibiotic prophylaxis was not deemed necessary for the extraction of deciduous incisors or cuspids unless "gum infection" was present, but its use was recommended for deciduous molars and all permanent teeth.

A significant recent development on this topic is the decision by the Rheumatic Fever Clinic at the Medical College of Virginia to refrain from using penicillin prior to tooth extraction on patients with rheumatic heart disease unless gross dental infection is present. This group feels that streptococcus viridans is especially prone to become resistant to penicillin in small dosage, and if this organism later became the cause of bacterial endocarditis tremendous dosages of penicillin would be required in treatment. These workers feel that only about 1 case in 2000 will result in bacterial endocarditis if no drug is used.[6]

Septicemia

Septicemia should be suspected whenever chills and fever are present, and the temperature curve shows "steeplejack" peaks every few hours or days. The malaise and other symptoms of acute illness are more marked during the extremes of the febrile reaction. Since bacteria are in the blood stream more or less continuously, it is evident that they are growing and multiplying in some organ or tissue of the body as well as in the blood itself. The treatment is medical, and now consists essentially of specific antibiotic therapy in high doses.

Pyemia

Some types of organisms, particularly staphylococci, are prone to develop metastatic abscesses after being carried through the blood stream from an original site of infection to a distant point. In addition to the medical treatment required for septicemia, surgery in the form of drainage of abscesses may be required to control the secondary infections in liver, kidney, bones, etc.

Cavernous Sinus Thrombosis

Cavernous sinus thrombosis, fortunately quite a rare condition, usually develops from a pyogenic infection in the middle facial area

which is aggravated by trauma. A frequent cause is the squeezing of a boil or pimple on the upper lip. The infection enters the angular vein and produces thrombosis which extends up into the cavernous sinus in the anterior cranial fossa. Brain abscess, meningitis, generalized septicemia, and death follow quickly in cases untreated with antibiotic and anticoagulant therapy. The mortality, formerly 100 per cent, is still high, even with prompt, effective treatment.

Recommended Precautions. If surgery or manipulation of any kind must be performed upon acute infections in the upper jaw or facial area, trauma should be kept to an absolute minimum and antibiotics should be administered prophylactically.

Focal Infection

Shortly after the turn of the century the theory of Billings and Rosenow was widely followed, which held that bacteria in the teeth, tonsils, prostate, gallbladder, or other organ could migrate through the blood stream and produce chronic disease of the joints, kidney, heart, brain, or other vital structure.[7] It was felt that the localization of the bacteria was specific as to organ or tissue. Animal experiments were reported which seemed to support the thesis. For example, bacteria removed from a human gastric ulcer produced lesions of the wall of the stomach when injected into a rabbit.[8]

Although the theory came under heavy attack from those who stated that the experiments could not be duplicated by others, it was widely applied in clinical practice and is still the basis for much medical and surgical treatment today. Unfortunately, at the peak of its highest popularity, the principle was not always applied with good judgment. Many arthritis patients had all of their teeth extracted simply because some carried rather extensive dental restorations. Needless to say, improvement in the systemic condition did not always follow.

Condemning of teeth in patients with arthritis or some other condition where an etiological focus is suspected, should always be a joint enterprise of dentist and physician. The physician should carefully weigh the probable gain to be derived from extractions, so that strategically valuable teeth are not needlessly sacrificed. The dentist must realize that there are occasions when the health of the individual must be given greater consideration than individual units of the dentition, and when the physician feels that the patient's welfare demands removal of every pulpless tooth, these should be extracted even though important from a dental standpoint.

While some physicians are unfortunately not aware of it, all dentists know that dental radiographs made in an effort to find a "focus of infection" must be of the highest quality and must be interpreted by someone thoroughly grounded in oral anatomy, oral pathology, and the variations of normal appearance which simulate but must be differentiated from disease.

In the chapter on Infections, the diagnosis and management of chronic lesions will be discussed in a manner which neither ignores

nor heartily endorses the focal infection theory. If the dentist sincerely tries to keep his patients' teeth and oral tissues in a state of health, there should be no reason to suspect that distant organs will become infected from them.

To sum up the discussion of this controversial subject, it may be pointed out that the general idea of the theory of focal infection is entirely consistent with many of the views of those who reject the theory. Chronic oral infection may be considered as a "load" which the patient carries through sickness and health. It does him no good, and in periods of lowered resistance becomes a distinct liability. Under the beliefs of either school of thought, chronic dentoalveolar disease should be removed by appropriate therapeutic measures.

CARDIOVASCULAR DISEASES

The dentist is unwise to make a practice of listening to hearts with a stethoscope in an effort to distinguish between functional and organic disease. The loudness of a murmur is no index of the amount of damage present. Evaluation of the physical findings derived from cardiac examination is one of the most difficult skills in the field of medicine. In the same manner, for a dentist to take the blood pressure as a part of preoperative examination is to imply that he is qualified to rule on the status of the blood vessels, brain, kidneys, and ocular fundi. There is no moral wrong in a dentist's occasionally using the stethoscope or sphygmomanometer, providing he understands the limitations of the information secured therefrom. Experience has shown that when a dentist receives some training in physical diagnosis, as in an oral surgery graduate program, he becomes even more conservative than formerly, and is all too willing to defer to the physician for an opinion on the heart and blood vessels.

Hypertension

Elevation of the blood pressure, as such, does not constitute an absolute contraindication to oral surgery. However, patients with this condition may have associated kidney, brain, or cardiac disease which may make them poor operative risks. When the usual preoperative interrogation elicits symptoms suggestive of cardiovascular disease, with or without renal damage, the patient should be referred to the physician for evaluation, and advice sought regarding any special precautions to be taken.

General Precautions: Premedication with barbiturates, reduction or elimination of epinephrine from the local anesthetic solution, and limitation of the quantity of surgery for the first sitting are recommended.

Diseases of the Heart

Congenital Heart Disease. There are many types of congenital heart defects, some relatively unimportant, and some barely com-

patible with life. It must be assumed that these hearts are all fertile soil for the development of subacute bacterial endocarditis. The request for medical advice should seek information on the prognosis for life, the need for antibiotic premedication, and special anesthetic requirements.

General Precautions: The patient should be premedicated with antibiotics and, if general anesthesia is used, the oxygen concentration should be maintained at 40 per cent or higher.



FIG. 12 Mitral stenosis resulting from rheumatic fever (Bell's *Textbook of Pathology.*)

Rheumatic Heart Disease. When a patient states, during the taking of the history, that he has had rheumatic fever, inflammatory rheumatism, chorea, or St. Vitus' dance, it should be assumed that there has been scarring of the valves of the heart. If the patient is not decompensated, and the appropriate antibiotic therapy is used, there is every reason to anticipate a normal operative and post-operative course. Medical consultation is desirable but not imperative.

General Precautions. Every case must receive prophylactic antibiotic therapy.

Subacute Bacterial Endocarditis. This condition, uniformly fatal prior to the antibiotic age, characterized by fatigue, lassitude, septic

temperature, chills, fever, embolic phenomena, and a positive blood culture, is so grave that no surgery should be performed without complete medical approval and supervision. Only the most minor procedure should be considered even under these conditions.

General Precautions: Oral surgery should be postponed until recovery.



FIG 13 Massive edema resulting from cardiac decompensation which followed rheumatic heart disease (Yater, *Fundamentals of Internal Medicine,* courtesy of Appleton-Century-Crofts)

Syphilitic Heart Disease. The effect on the valves is similar to that produced by rheumatic fever. Aortitis and aneurysm may be present. Rupture of the latter during the stress of oral surgery is a remote possibility.

General Precautions: The patient should be premedicated with antibiotics, as in all cases of valvular defects.

Coronary Disease. (1) *Angina Pectoris.* Patients with pure angina, who have had no episodes of occlusion, will usually tell the dentist about their trouble and display their bottle of nitroglycerin

tablets, to be used in an emergency. The cardinal symptoms are precordial pain and dyspnea, produced by exertion or severe emotional stress.

General Precautions: Premedication with barbiturates is desirable. The vasoconstrictor should be greatly reduced or eliminated from the anesthetic solution, and nitroglycerin tablets should be available, for placement beneath the tongue if an attack occurs.

(2) *Coronary Occlusion.* Patients with a history of this serious disorder should not be submitted to oral surgery until competent medical opinion has been secured.

General Precautions: It is recommended that barbiturate premedication be used, epinephrine reduced or eliminated from the local anesthetic solution, excessive blood loss be avoided, and oxygen kept above 40 per cent if general anesthesia is used.

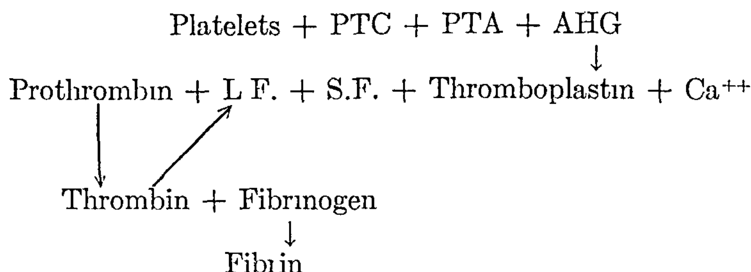
Cardiac Decompensation. Heart failure may result from any disease process that increases the work load or impairs the functional efficiency of this organ. Decompensation comes on gradually, being manifested by subtle symptoms and signs over a long period of time. Swollen ankles, increase in weight, shortness of breath on exertion, and symptoms resulting from the chronic passive congestion of viscera may be present.

General Precautions: Medical counsel is imperative. Only emergency surgical procedures should be considered. Premedication with barbiturates and antibiotics is indicated.

BLOOD DYSCRASIAS

Defects in the Clotting Mechanism

Frick has evolved the following diagram to outline the present conception of the mechanism of clotting of the blood.[9]



PTC Plasma thromboplastin component
PTA Plasma thromboplastin antecedent
AHG Anti-hemophilic globulin
L F. Labile prothrombin conversion factor
S.F. Stable prothrombin conversion factor

This rather complex process may be somewhat simplified by dividing it into three stages: the formation of thromboplastin, the formation of thrombin, and the formation of fibrin.

Hemophilia. This disease is, fortunately, rare. For practical purposes it may be assumed to occur only in males. The bleeding time is normal but the coagulation time is greatly prolonged, due to a deficiency of AHG, PTC, or PTA. Frick found that AHG was the deficient factor in 77 per cent of a group of 35 patients with hemophilia. Replacement of the missing factor by transfusion with whole blood, plasma, or AHG is rational, but unfortunately these needed substances disappear from the blood stream rather promptly after they have been introduced, so that reduction of clotting time by transfusion is a temporary expedient. In some instances the improved coagulability of the blood remains for only a few hours. The normal bleeding time in patients with hemophilia is explained by vasoconstriction and formation of a platelet thrombus. In small wounds the thromboplastin necessary to produce clotting of the platelets is derived from nearby injured tissue cells. In a large wound, such as a tooth socket, this amount of thromboplastin is insufficient to produce a clot.

*Purpura Hemorrhagica.** *Essential thrombocytopenic purpura* is characterized by a deficiency in the number of platelets. The prolonged bleeding time is explained by the insufficient number of platelets to form a plug even for small vessels. The coagulation time is normal, but the clot does not retract. This type of purpura is frequently cured by splenectomy.

In any type of *leukemia,* the megakaryocytes may be unable to produce their proper quota of platelets due to overcrowding or destruction by the leukemic elements in the bone marrow, and a bleeding tendency results.

In *aplastic anemia,* which represents exhaustion of the bone marrow, all of the cellular blood elements derived from the bone marrow, including the platelets, are produced in inadequate numbers.

Purpura may occur with vitamin C deficiency and from the effect of certain poisons and bacterial toxins, even though the platelet count is normal.

Vitamin K Deficiency. It is believed that the action of this substance is enzymatic, and essential for the formation of prothrombin. It is synthesized in the intestinal tract by the assistance of bacteria, in the presence of bile. Bleeding due to a lack of vitamin K can thus occur when there is biliary obstruction. Patients receiving Dicumarol to prevent the formation of intravascular thrombi may be returned to the state of normal coagulability promptly by the administration of vitamin K.

Recommended Precautions for All Patients with a Tendency to Bleed: The best general advice is *never* to extract a tooth for a hemophiliac patient. If one will pause to remember that many of these people lose their lives as a result of removal of a tooth, he will usually find some other way of relieving pain and controlling sepsis.

* Portions of the remainder of this chapter are based in part on material from Bell's *Textbook of Pathology*

If extraction is imperative, the patient should be hospitalized under the care of a competent internist and oral surgeon.

Whenever extraction is to be performed for a patient with a known tendency to bleed, he should be cross-matched and an ample supply of blood of the proper type and Rh factor made available. Placement of a saddle-like splint, made up of vulcanite or acrylic prior to extraction, will often aid materially in reducing the period of postoperative bleeding. The use of small rubber bands for the

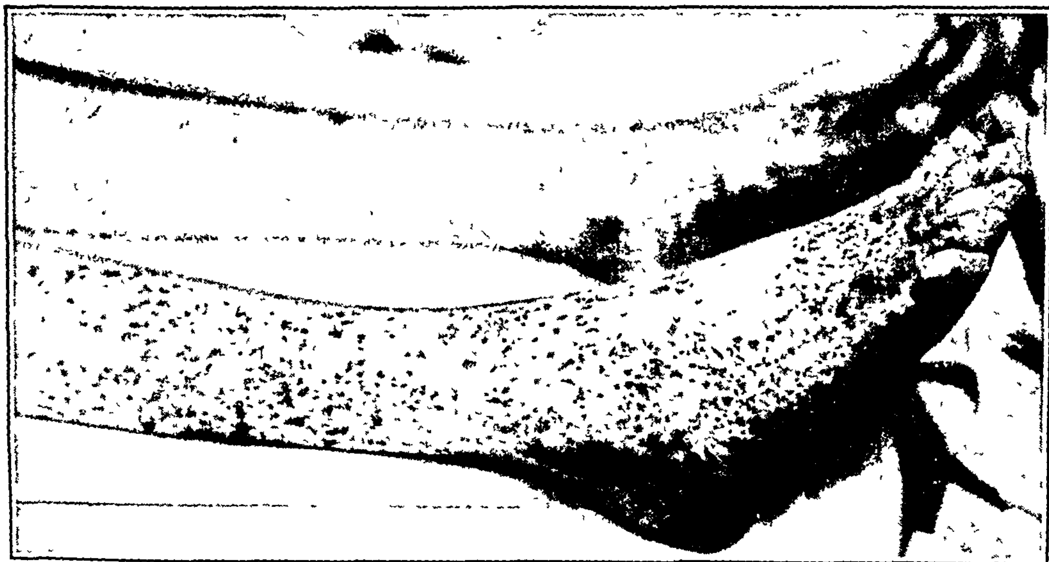


FIG 14 Purpura associated with scarlet fever. (Fox and Enzer, Am J Med Sci.)

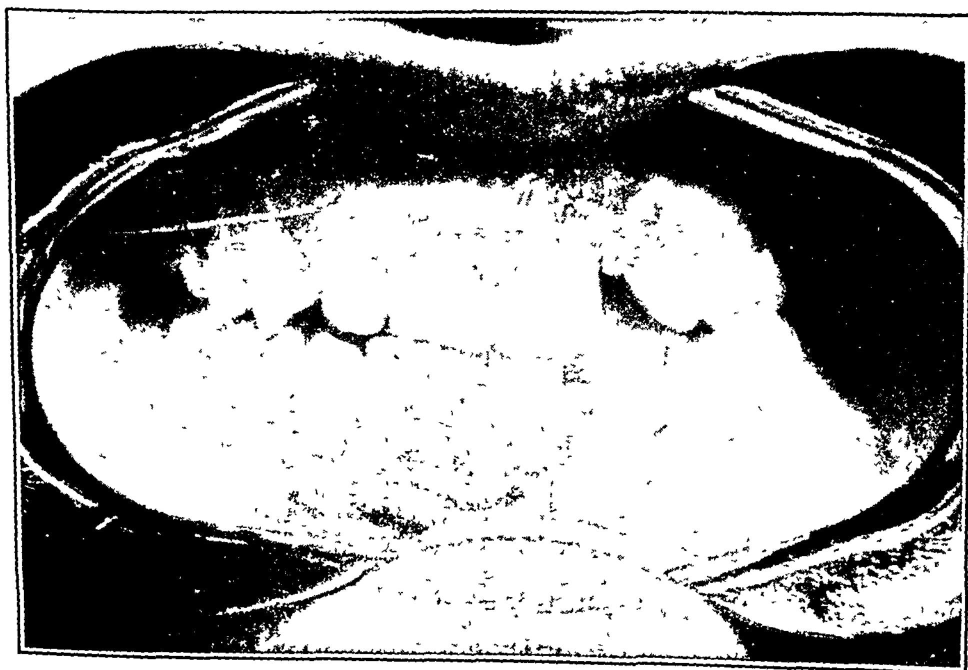


FIG 15. Leukemia.

purpose of exfoliating teeth has been recommended by Birch and Snider.[10] Packs of gelatin sponge saturated with bovine thrombin will be of some assistance in securing coagulation.

All hematologists feel that the administration of calcium is not rational as an aid to coagulation of the blood, as a hypocalcemia which would be severe enough to retard clotting would be incompatible with life. The empirical administration of vitamin K is not recommended; it should be reserved for those cases which have the specific avitaminosis.

In the only case I have seen with proven capillary fragility, repeated packing of the wound with epinephrine was the only measure which was effective.

Hemoglobin Deficiencies

There are two prime points of interest associated with low hemoglobin, whether it is due to *primary pernicious anemia* or one of the secondary types. The first is the hazard of anoxia during the course of general anesthesia. A severely anemic patient will not show cyanosis with low concentrations of oxygen that would give this warning sign in a normal subject. As a consequence there may be severe damage to the brain, heart, or other vital organs. The second aspect of low hemoglobin which relates to oral surgery is in regard to the healing of wounds. The tissues must receive an adequate supply of oxygen to repair the damage produced by disease or surgical trauma.

Recommended Precautions. The hemoglobin should be brought to normal by blood transfusions or other appropriate medical therapy before any operation, particularly if it is to be under general anesthesia. In the event that a short anesthetic must be administered to a moderately anemic patient, the oxygen concentration should be kept high.

Agranulocytosis

In this frequently fatal disease there is a severe reduction in the number of the neutrophils in the circulating blood. Ulcers develop on the mucous membranes of the throat and mouth. Resistance to infection is sharply reduced.

General Precautions: No surgery should be performed.

KIDNEY DISEASE

The kidneys may be the site of primary disease, or may be secondarily affected by other pathological processes. It has been estimated that an individual can survive and lead quite a normal life even though one and one-half kidneys are removed by surgery or destroyed by disease.

Any patient with severe renal disease such as nephrosis, nephritis, arteriosclerotic kidney disease, or tumor should be given medical clearance prior to any operation. Chronic oral sepsis could initiate

nephritis by the mechanism of focal infection, or a transient bacteremia produced by tooth extraction might cause a quiescent focal embolic or diffuse glomerulonephritis to flare up. Bell feels that patients with kidney disease should be subjected to extractions in the same manner as normal individuals—no more and no less.

Recommended Precautions: Medical consultation should be obtained for any patient with kidney disease. Antibiotic therapy should be used to counteract reactivation of previous kidney infection.

DISEASES OF THE NERVOUS SYSTEM

Organic

NEURITIS

True inflammation of a peripheral nerve, with pain associated with paresthesia, anesthesia, or paralysis, is rarely seen. The condition lies within the field of medicine rather than oral surgery.



FIG. 16 FIG 17

FIGS 16 and 17. Typical facial expression (left) when smiling and (right) when at rest in a patient with Bell's palsy on the right side. (Burket, *Oral Medicine*, courtesy of J B Lippincott Co)

SEVENTH NERVE PARALYSIS

When this spectacular and distressing affliction occurs spontaneously, it usually is the result of exposure to cold or a draft (Bell's Palsy.) It might better be classified under the functional diseases of the nervous system, though it is felt to have an organic basis. The mechanism is probably that of edema of the nerve in the portion where it is confined in the facial canal. Spontaneous recovery in a few weeks is the rule, but cases which persist longer should receive the attention of a neurologist for possible electric stimulation to prevent degeneration of the peripheral nerve and atrophy of the facial muscles.

Accidental sectioning of a main branch of the seventh nerve during operations through the skin in the region of the ear is one of the dreaded complications of operations upon the condyle or upper portion of the ascending ramus. The most serious consequence is inability to close the eyelids. This does not lead to ulceration of the cornea, however, since sensation is derived from the first division of the fifth nerve.

LESIONS OF THE BRAIN AND CORD

Brain tumor, abscess, arteriosclerosis, multiple sclerosis, meningitis, encephalitis, cerebral palsy, poliomyelitis, and epilepsy call for medical consultation regarding the propriety of performing operations within the mouth, and specific suggestions for details of management. Patients with organic brain disease frequently have personality changes and impairment of intellect. They must be handled with sympathetic understanding mingled with firmness.

If the primary condition is associated with paralysis of muscles in the palate, pharynx, or glottis, extreme care must be used in administering general anesthesia to prevent asphyxia. Such individuals carry an added risk even for routine dental work, for when the protective cough and gag reflexes are absent, foreign bodies might be aspirated or swallowed.

Functional

TRIGEMINAL NEURALGIA (Tic Douloureux)

It is important for the dentist to know the features that distinguish this entity from the pain of pulpitis, alveolar abscess, maxillary sinusitis, temporomandibular joint disorders, and atypical neuralgias.

Trigeminal neuralgia usually comes on between the ages of forty and sixty. The pain is sudden, severe, shooting, and burning in quality. It is limited to the distribution of one or more branches of the fifth nerve. Each attack is brief, lasting only a few seconds. At first the seizures may be months apart but the interval between them gradually shortens as time goes on. A trigger zone on the face or within the mouth may be present, which, when touched, sets off the paroxysm. The patient will often leave that side of the face unwashed and unshaven, and protect it with a shawl in cold or windy weather. Weight loss, severe apprehension, and depression follow, leading to suicide in unrelieved cases.

When these features are kept in mind, differential diagnosis should not be too difficult Due to the very serious nature of the affliction, and the excellent results that may be achieved by competent neurosurgical care, it is the author's belief that these patients should be referred at once to the neurosurgeon or neurologist, so that he may see the condition in its unaltered state, and give the patient information about the surgical procedures which are available.

Peripheral alcohol injections of the mental, mandibular, or infraorbital nerves can, if successful, give relief by providing complete anesthesia for periods ranging from six to eighteen months. How-

ever each injection produces some fibrosis, and the period of relief becomes shorter and shorter with each repetition. Sometimes a continuous, burning pain, rather than anesthesia, results from alcohol injection, and slough of tissues has been known to occur.

Neurosurgeons customarily perform one or more alcohol injections prior to doing the sensory root sectioning operation proximal to the semilunar ganglion. This is done to acquaint the patient with the sensation of numbness which will be permanent after the operation. It also builds the patient's confidence in the individual who is to perform the delicate but vitally significant procedure.



FIG 18 Facial expressions during attack of trigeminal neuralgia (Bonica, *The Management of Pain*)

Some patients with tic douloureux are so emaciated and weakened by the time they reach the neurosurgeon that they are poor risks for any type of surgery, yet cannot be injected with alcohol because the possibilities have been exhausted by those who rendered the previous care. This is particularly true when the semilunar ganglion has been injected with alcohol a number of times.

One prominent neurosurgeon has reported that most of his patients with tic douloureux come to him with all upper and lower teeth extracted on the affected side, still suffering from agonizing attacks of pain. This leads him to feel that too many dentists are inadequately informed about the diagnostic signs of major neuralgia, as it is evident that the diagnosis is frequently missed.[11]

Recommendations: A patient with the history and findings of trigeminal neuralgia should be referred at once to a competent

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Trigeminal neuralgia usually comes on between the ages of forty and sixty. The pain is sudden, severe, shooting, and burning in quality. It is limited to the distribution of one or more branches of the fifth nerve. Each attack is brief, lasting only a few seconds. At first the seizures may be months apart but the interval between them gradually shortens as time goes on. A trigger zone on the face or within the mouth may be present, which, when touched, sets off the paroxysm. The patient will often leave that side of the face unwashed and unshaven, and protect it with a shawl in cold or windy weather. Weight loss, severe apprehension, and depression follow, leading to suicide in unrelieved cases.

When these features are kept in mind, differential diagnosis should not be too difficult. Due to the very serious nature of the affliction, and the excellent results that may be achieved by competent neurosurgical care, it is the author's belief that these patients should be referred at once to the neurosurgeon or neurologist, so that he may see the condition in its unaltered state, and give the patient information about the surgical procedures which are available.

Peripheral alcohol injections of the mental, mandibular, or infraorbital nerves can, if successful, give relief by providing complete anesthesia for periods ranging from six to eighteen months. How-

category. The vicious cycle of this situation produces palpitation, dry mouth, sweating of the palms, the general awareness of not feeling well. Each of these symptoms causes more anxiety, and the cycle is continued.

Recommended Precautions: The dentist will seldom get into difficulty with psychoneurotic patients if he will always limit his operations to legitimate, organic, objective situations. These people develop dental decay, infections, and tumors just as do normal individuals, and the appropriate care should be given them. However, on occasion they will request a dentist to perform some operation which they fancy to be necessary, when the indication simply is not there. In this direction lies nothing but difficulty!

In appropriate instances the dentist should refer these people for psychiatric aid. Many of them can be helped by coming to understand their difficulty, facing it squarely out in the open, and then dealing with it in the proper perspective.

The Psychoses

There are three main types of major psychosis. All are truly functional diseases, in that no changes are found at autopsy. It is important that the dentist know something of these disorders for they are more frequent than is commonly believed, and he will certainly encounter patients in the early stage of serious mental disorder from time to time. Dentists working in mental hospitals have the advantage of knowing the diagnosis and may be guided in their management by the medical information on the record. The dentist caring for the general public, however, is under a handicap when he encounters a bizarre mental attitude, for it is not incumbent upon him to make a diagnosis which is difficult at best.

1. *Paranoia.* This type constitutes a rather small percentage of cases of major psychosis. The predominant feature is a persistent feeling of persecution. These individuals have fixed false delusions which may lead them to attack and kill, in the belief that they are in actual danger. The prognosis is poor.

2. *Manic Depressive Psychosis.* This much commoner type is cyclic in nature. It usually occurs in adults in the young or middle age group. The prognosis for any individual attack is excellent, as the patient usually makes a complete recovery. However, repeated attacks are the rule. The true *manic* is tremendously overactive, sleepless, expansive, and elated. He makes countless plans involving large sums of money he does not possess, and is intolerant with those who are not sympathetic with his exuberant feelings. Sleeplessness leads to inefficiency, forgetfulness, and extreme irritability. The manic phase may give way to severe *depression*, a state exactly the opposite from the mania. The patient sits morosely for hours on end, lamenting his burden of sadness, crying, and unable to see anything optimistic or cheerful in the world about him. It is in this phase of the disease that suicide is a very serious possibility. The tragedy is all the worse when it is remembered that each attack is

neurologist or neurosurgeon. The teeth and jaws should be examined thoroughly in the usual manner, but the error of extracting clinically and radiographically negative teeth should be avoided.

Atypical Neuralgia

This rather general term is applied to those conditions characterized by pain over the distribution of a nerve, for which no explainable cause can be found. The history does not fulfill the criteria for trigeminal neuralgia, and the patient usually says the pain is continuous. These people truly suffer pain, but it is probable that in most cases it has a psychosomatic basis.

The Psychoneuroses

These are the milder functional mental disorders. They seldom if ever require institutional care, but cause the patient and his family much concern. The average dentist will see these conditions much more frequently than the major psychoses. Every practitioner has patients whom he has diagnosed, probably correctly, as "neurotic." It is difficult at times for even the trained psychiatrist to draw definite lines between mental normalcy, psychoneurosis, and psychosis. Many individuals are subject to periods of worry, mild depression, or a feeling of unusual well-being. These changes in mental outlook are the inevitable consequence of exposure to the stresses and vicissitudes of modern living, and no one would be quite normal without them. It is only when some adverse feature is persistently present, so that it works to the disadvantage of the individual or his family, that an abnormality may be said to exist.

Four types of psychoneurosis have been recognized by Stecker, Ebaugh, and Ewalt [12]

1. *Conversion Hysteria.* This type of disorder is a replacement process The patient represses some experience until it ceases to exist in his conscious thought processes. In its place there is some imaginary situation or pattern of thought. Some of the psychosomatic disorders, including pain and disability of a part of the body, are of this type. Hysterical closure of the jaws, which simulates organic trismus or ankylosis, is one of the manifestations of this type which is occasionally seen.

2. *Neuresthenia.* This is the state of chronic fatigue, with palpitation of the heart on exertion, headaches, sinking spells, and so on.

3. *Compulsion Neuroses.* These abnormalities take the form of persistent ideas which must be acted upon. The "washing mania" in which the hands must be cleansed immediately after touching any unclean object, is an example. There are patients who are obsessed with the thought that they need an operation or some particular type of dental treatment. The fixed idea is unreasoning and inordinate.

4. *Anxiety Neuroses.* These are the persistent, nagging, ill-defined fears. The cancerophobe and syphilophobe belong in this

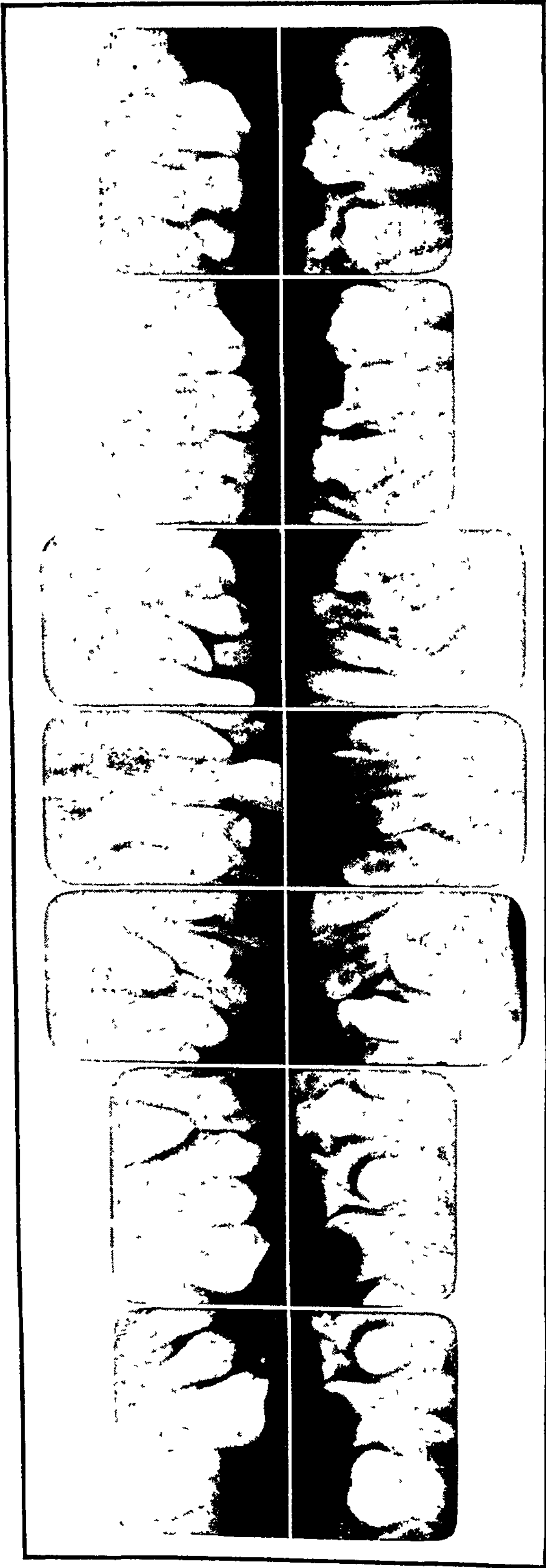


Fig. 19. Cretinism. Delayed eruption of teeth in 19-year-old girl.

self-limited, and recovery is the expected probability, if the patient can be protected from himself. Some individuals develop only the manic phase, others have only depressions, and still others undergo cycles from one to the other.

A less severe form of the manic type is known as *hypomania.* These people exhibit a press of activity, flight of ideas, loss of sleep, make many plans—few of which are ever carried to completion because others which are more intriguing beckon before the first are done—spend all of their money, but are highly amusing to strangers, while a serious worry to their families. Judgment is impaired and insight into the condition is lost. These patients also may go into a depression and become suicidal.

Electroshock therapy has been a godsend to many people suffering from manic depressive psychoses. Institutional care, with absolute confinement, is essential to prevent suicide or complete exhaustion of all of their financial resources.

3. *Schizophrenia* (*Dementia Praecox*). This term literally means "split personality." The patient, usually a young individual, becomes withdrawn into himself, away from the world about him. While the manic depressive retains the emotional elements of his behavior, in fact greatly exaggerates them, the schizophrenic loses the emotional features, becoming more and more apathetic. In spite of the various forms which the disease may take, hebephrenic, catatonic, or paranoid, the basic feature of lack of the "affect" or emotion may be seen running through all activity and mental processes. Although electroshock treatments, prefrontal lobotomy, and other modern forms of therapy have done much for this type, the prognosis is unfavorable, and many cases remain institutionalized for life.

Recommended Precautions. In dentistry, where virtually all treatment is elective, it is important that the practitioner not become embroiled in awkward or dangerous situations that are a direct result of a patient's abnormal mental processes. Reference should be made to the section of the book dealing with selection of patients for surgery (p. 33), particularly the remarks on patients who apparently do not have a clear understanding of the purpose of proposed treatment.

DISEASES OF THE ENDOCRINE GLANDS

The Thyroid

Hyperthyroidism. The presence of adenomatous goiter is of no clinical significance in oral surgery unless there are toxic symptoms. However, the patient with hyperthyroidism due to toxic adenoma or diffuse hyperplastic goiter is a poor candidate for any surgical procedure. Both are much more frequent in the female. Exophthalmos is not pathognomonic of this condition and should be minimized as a diagnostic clue, since some normal individuals have



Fig. 19. Cretinism Delayed eruption of teeth in 19-year-old girl.

features which suggest this finding. On the other hand, weakness, loss of weight accompanied by increased appetite, tachycardia, sweating, and nervous instability should immediately arouse the suspicion of thyroid disease, and medical consultation should be requested. Heart failure may occur due to exhaustion from overstimulation by the excess of thyroxin. The oxygen requirement of these patients is high, due to the increased metabolic rate.

General Precautions: No surgery should be done in severe cases until medical control has been achieved. In mild cases heavy barbiturate premedication is needed for work under local anesthesia. If general anesthesia is to be used, the oxygen concentration should be kept high.

Hypothyroidism. Deficiency of thyroid secretion in the child produces the condition of *cretinism* or juvenile myxedema, characterized by thick, dry skin, sparse, dry hair, subnormal mental and physical development, and a dentition that is delayed in eruption and prone to early decay.

In the adult, spontaneous hypothyroidism produces effects which are similar to those of the cretin, but since growth has been completed, they are not so dramatic, and may be missed on the examination. The condition, known as *myxedema*, results in cold, thick, dry skin, large tongue, lowered basal metabolic rate, with cardiac enlargement which eventually leads to failure.

General Precautions: Medical approval should be received for any contemplated surgery.

THE PARATHYROIDS. The condition of interest to the dentist is hyperparathyroidism due to the presence of a parathyroid adenoma. This is usually associated with generalized osteitis fibrosa cystica (von Recklinghausen's disease of bones.) The clinical effects noted are weakness, polyuria, high serum calcium, and low serum phosphorus. Radiographic examination of the bones, including the jaws, shows a loss of calcium and there may be cyst formation. The lamina dura of the tooth sockets is frequently destroyed. Spontaneous fractures may occur. Urinary calculi are often present.

General Precautions. The dentist may be in a position to assist in making the diagnosis through his dental radiographic examination Surgery should be deferred until the more serious systemic condition has received proper attention.

THE PITUITARY. This tremendously important structure has been studied intensively in recent years, with the result that much is now known about not only the direct effects of its secretions, but also the indirect effects which have an influence upon other glands of internal secretion.

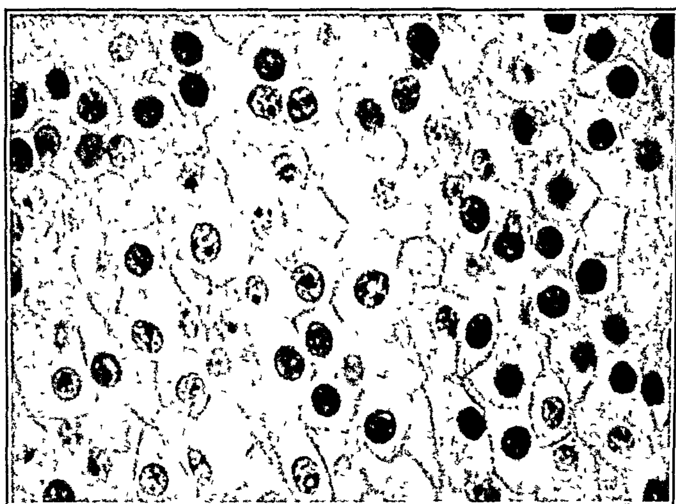
The posterior lobe, or pars nervosa, produces pitressin, which causes a transient rise in blood pressure and acts as an antidiuretic, and an oxytoxic substance called pitocin, which acts upon the uterine musculature to produce contraction. *Diabetes insipidus* is a rare condition characterized by an enormous output of urine of low specific gravity, accompanied by insatiable thirst. In some cases these



Fig. 20 Demineralization of alveolar bone and loss of lamina dura in hyperparathyroidism.

effects can be reduced by the injection of pitressin. The posterior lobe of the pituitary and nearby portion of the brain are anatomically and functionally related as a unit. Tumors or other lesions of either structure may produce diabetes insipidus.

The anterior lobe contains three types of cells: chromophobe, acidophile, and basophile. Some of the effects of the anterior pituitary can be traced to one of the particular types of cells; others have not been specifically associated. It is believed that the acidophile



A



B

Fig 21. *A*, Parathyroid adenoma × 500 *B*, Osteitis fibrosa, showing marked osteoporosis and absorption of bone × 50 (Boyd's *Textbook of Pathology.*)

cells are the type responsible for effects on growth, such as gigantism and acromegaly. In addition to the growth regulating hormone, the existence has been determined of gonadotropic, thyrotropic, diabetogenic, adrenotropic, and lactogenic hormones.

One of these substances, adrenocorticotropic hormone (ACTH) acts upon the adrenal cortex to produce a number of important functions. It might be said that the anterior pituitary keeps the adrenal cortex alive and strong (trophic means strength or health). It is known that the adrenal cortex produces at least three types of hormones: (1) S or sugar hormones, (2) N or nitrogen hormones, and (3) salt hormones. Cortisone, also known as compound E, is an example of an S hormone. It is the only one which has been synthesized up to the present. The effect of these substances is to bring about sodium, chloride, and water retention, loss of nitrogen in the urine, and elevation of urinary corticoids and 17-ketosteroids. These hormones act back upon the anterior pituitary, repressing it. The giving of ACTH also acts to suppress anterior pituitary activity. The adrenal cortical hormones control the conversion of fat and protein into carbohydrate.[13] Depletion of body proteins occurs when ACTH or cortisone are administered. Since proteins have to do with immune bodies and the defense reaction of the body, this occurrence is adverse to the mechanism of healing, repair, and the fighting of infection.

Both ACTH and cortisone have been widely used in the treatment of rheumatoid arthritis, allergic disorders, rheumatic fever, and others of the collagen disease group. The effect is essentially the same, whichever preparation is used. The improvement in these patients lasts as long as the drug continues to be given. The specific effects that occur are reduction of inflammation, sedimentation rate, malaise, and fever. Excessive use may give rise to a symptom complex resembling Cushing's syndrome. Long continued use of ACTH may produce hypertrophy of the adrenal cortex, or, on the other hand, may exhaust it from overstimulation. Old duodenal ulcers may flare up and hemorrhage under this form of therapy. Furunculosis and tuberculosis are absolute contraindications for its use. The status of adrenal cortical activity may be tested by determination of the number of eosinophils in the circulating blood and the quantity of steroid substances being excreted in the urine.

Recommended Precautions: No patient who has been receiving sizable doses of ACTH or cortisone over an extended period should be submitted to *any surgical procedure whatever* until the status of adrenal cortical activity has been carefully appraised. The possibility of sudden, severe, irreversible shock is very likely in a patient who has received this type of therapy within the past year, *but who is not receiving the substance at the time of operation.* Even the most trivial operation may prove fatal under these circumstances. Salassa *et al.* have found that such patients may be rendered safe surgical risks by again administering intramuscular injections of cortisone for several days prior to and following surgery.[14] The

explanation for this phenomenon lies in the fact that patients whose adrenal cortex is not functioning are unable to stand any form of "stress." Artificial replacement of the lacking substance permits them to react in a more normal manner.

Since ACTH and cortisone inhibit the inflammatory reaction, it has been feared they would interfere with the healing of wounds, which effect would be of interest in oral surgery. Experience has not borne out the prediction, at least not to the extent which was ex-

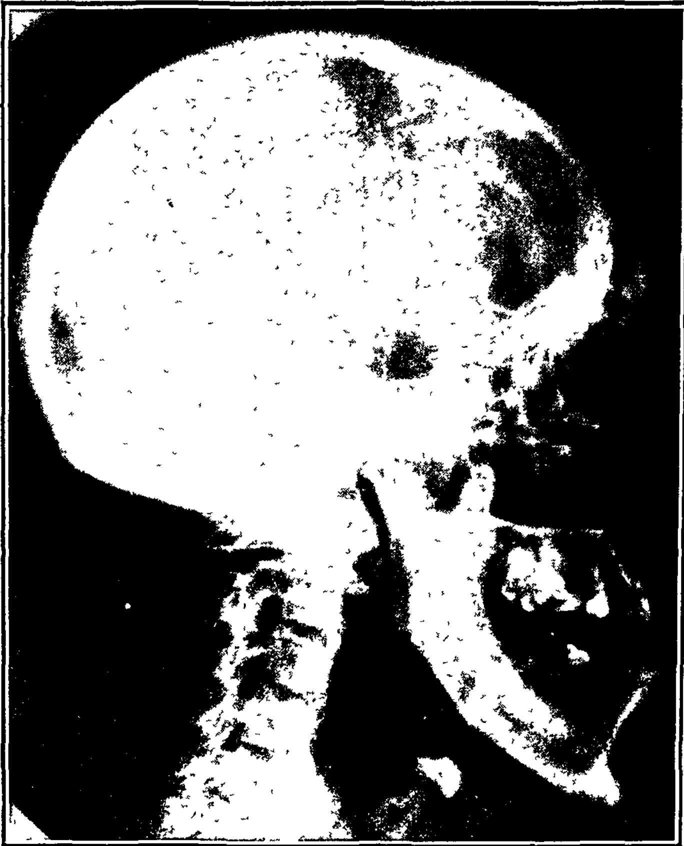


FIG 22 Acromegaly (Musser and Wohl, *Internal Medicine*)

pected. Tooth extractions can be performed for patients receiving this form of hormonal therapy with the expectation that healing will occur in an essentially normal manner.

Hyperpituitarism. *Gigantism* is quite certainly felt to be due to hyperplasia or an acidophilic adenoma of the anterior lobe, which is active early in the life of the individual. Delayed union of all epiphyses results in overdevelopment of all bones of the body.

Acromegaly results from overactivity of the anterior lobe of the pituitary commencing in adulthood. There is increased growth in those bones wherein the epiphyses have not yet united, particularly

the hands, mandible, and other bones of the head. The process may become stationary or continue to death. In the latter cases an eosinophilic adenoma is usually found at autopsy. Other body changes, such as alteration in the secondary sex characteristics, suggest the result of the influence of the pituitary over adrenal activity.

General Precautions: Mandibular resection may be indicated in cases of acromegaly, but it is desirable to limit surgery to those cases in which the excessive growth of the mandible has ended.

The Adrenals

Each adrenal gland is composed of an inner portion known as the medulla, which forms epinephrine, and an outer layer or cortex, possessing three layers. These are termed the juxtamedullary zone, the middle zone, and the outer zone. The juxtamedullary zone is now believed to produce androgenic substance, and is therefore functionally related to the gonads. The middle and outer zones are concerned with the metabolism of electrolytes.

The functions of the adrenals have been discussed along with those of the pituitary, as they are closely related.

Addison's disease is the result of destructive lesions of both adrenals. Pigmentation of the skin or mucous membranes of the mouth, severe weakness, gastro-intestinal symptoms, low blood pressure, and hypoglycemia are present. There is an excessive loss of sodium and chloride in the urine, with a corresponding decrease of these substances in the blood plasma. There is an increase of potassium ions in the blood. According to Bell, tuberculosis is the agency in over two-thirds of cases. Atrophy of the adrenals is frequently accompanied by a similar process in the thyroid, again pointing out the interrelationship between the various endocrine glands. The patient with Addison's disease may be kept alive by replacement therapy with desoxycorticosterone. Death occurs in "crisis" resulting from inability to respond to stress, due to insufficiency of adrenal cortical activity.

Cushing's syndrome is not attended by any one consistent pathological finding, but adenoma or hyperplasia of the adrenal is present frequently. Basophilic adenoma of the pituitary may cause the condition. The typical case has a moon face, pot belly, thin legs, hypertension, hyperglycemia and glucosuria, and dies in heart failure. There is a negative nitrogen balance, with resulting damage to the bones through destruction of the organic matrix.

Recommended Precautions: Patients with Addison's disease or Cushing's syndrome should receive no surgical care unless full collaboration with a competent internist is possible.

The Pancreas

Diabetes mellitus is the sole disorder of the pancreas which concerns the dentist, but it is so prevalent that he must be familiar with the basic pathological physiology as it relates to surgical considerations.

The diabetic is unable to utilize sugar properly for the production of energy, with the result that glucose accumulates in the blood stream and spills over into the urine when the blood sugar exceeds the renal threshold. This occurrence is due to an insufficiency of secretion of insulin by the islets of Langerhans in the pancreas. Diabetics are able to regain their ability to metabolize glucose when given insulin obtained from the pancreas of slaughterhouse animals.

The process is not quite this simple in actuality. The metabolism of glucose is related to that of fats, in that "fats are burned in the flame of the carbohydrates." Incomplete combustion of fats results in an accumulation of ketone bodies such as acetone in the body, and these substances are toxic. An uncontrolled severe diabetic

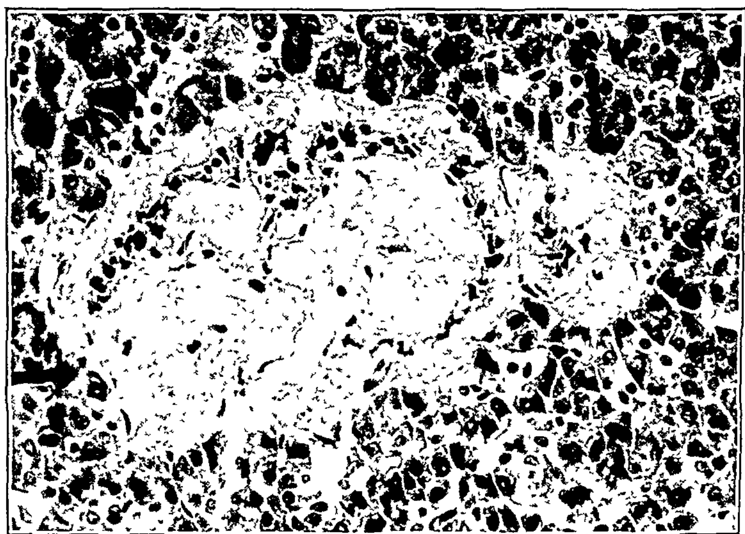


Fig 23 Diabetes Hyaline degeneration of islets of Langerhans of pancreas (Bell's *Textbook of Pathology*)

will therefore have sugar and acetone in the urine, an accumulation of these in the blood stream, and a reduced alkaline reserve due to depletion of the buffers in the blood, caused by acid substances resulting from incomplete metabolism of fats.

In general, diabetes is much more severe in young subjects than in the aged. Control by diet and insulin demands rigid discipline on the part of the patient, and many diabetics find it difficult to maintain the regimen necessary for complete control at all times. Diabetics must exercise regularly and avoid infections as much as possible, for a cold, an abscessed tooth, or appendicitis will alter the body physiology to such a degree that control is difficult to maintain.

Even though under good care, diabetics tend to develop atherosclerosis and coronary disease. The changes in the blood vessels impair the circulation so that gangrene, particularly of the toes, is a frequent complication in advanced age. Healing tends to be re-

tarded in any wound, which must be kept in mind in planning any oral surgical procedure.

The most dramatic crises in this disease are *diabetic coma* and *insulin shock*. Coma results from high blood sugar and a high concentration of ketone bodies in the blood, with a depletion of the alkaline reserve, *i.e.* acidosis. Insulin shock results from too much insulin, which may come from an actual overdose or from an insufficient intake of carbohydrate to use up the insulin. Diabetic coma is recognized by drowsiness, increased respirations, epigastric pain, vomiting, and unconsciousness. In the late stages, the distinction between coma and shock is not easily made. Characteristically, the patient in insulin shock suddenly develops hunger, weakness, profuse sweating, mental confusion, unconsciousness, then muscular twitchings which often progress to an epileptiform convulsion. The emergency treatment consists of giving sugar at once, preferably by mouth in the form of orange juice or sugar and water. Only rarely does death occur, but the grave importance of quickly evaluating the patient's condition cannot be overemphasized.

Medical students use a helpful code for remembering some of the conditions which can cause unconsciousness. Each has a first letter which is a vowel:

A lcoholism
E pilepsy
I nsulin
O pium
U remia

General Precautions: The fact that a patient is a diabetic will often be revealed by the routine questions which the thorough dentist will always include in his preoperative history, "Are you under the care of a physician, or are you taking any form of medicine?" Upon learning that the patient has diabetes the dentist should find out whether the patient is intelligently informed about his condition, and whether it appears to be under control, as evidenced by the patient's regular testing of his own urine. If there is any uncertainty, and in any case prior to extensive oral surgery, a direct report from the physician should be secured.

The use of antibiotics is rational, to preclude the possibility of postoperative infection, due to the tendency to slow healing.

Sugar in some form should be available in the event hyperinsulinism occurs No therapeutic preparations for the possibility of diabetic coma are recommended and would probably never be needed, since the onset of this development is gradual. The patient's complaint of not feeling well would be the signal to cancel the procedure until medical study could be conducted.

The middle aged patient with long standing diabetes should be classified as a likely candidate for coronary disease.

A diabetic patient may come to the dentist with an acute infection of the teeth or jaws. The fact that these patients handle in-

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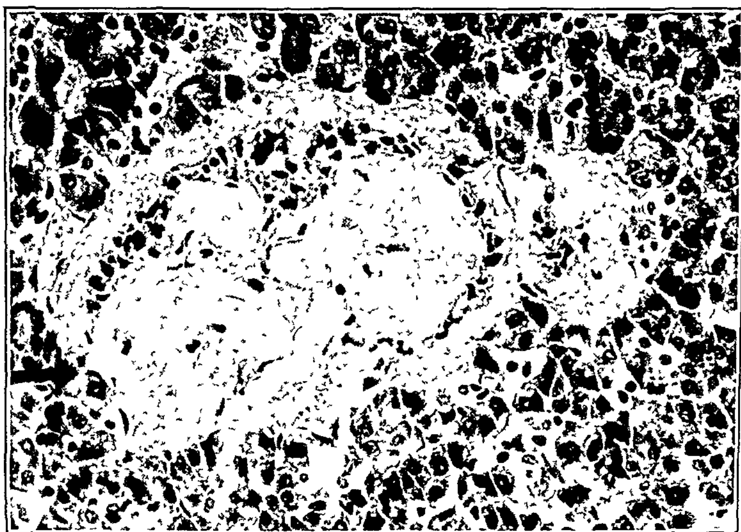


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The middle aged patient with long standing diabetes should be classified as a likely candidate for coronary disease.

A diabetic patient may come to the dentist with an acute infection of the teeth or jaws. The fact that these patients handle in-

fections poorly should be kept in mind. Often it will be difficult to control the diabetes while the infection is present, a situation which points out the vicious nature of the dilemma. Brief surgical procedures to relieve the acute infection, such as incision and drainage or simple extraction, will usually be encouraged by the physician, but during the course of this episode the dentist should maintain liaison with the medical attendant, for specific changes in the management of the diabetes may be required.

DISEASES OF THE RESPIRATORY SYSTEM

Acute Upper Respiratory Infections

The common cold, pharyngitis, influenza, and their numerous sequellæ such as tonsillitis, sinusitis, otitis media, and bronchitis are important because of their proximity to the dentist's field of operation and their highly infectious nature. It is probable that the

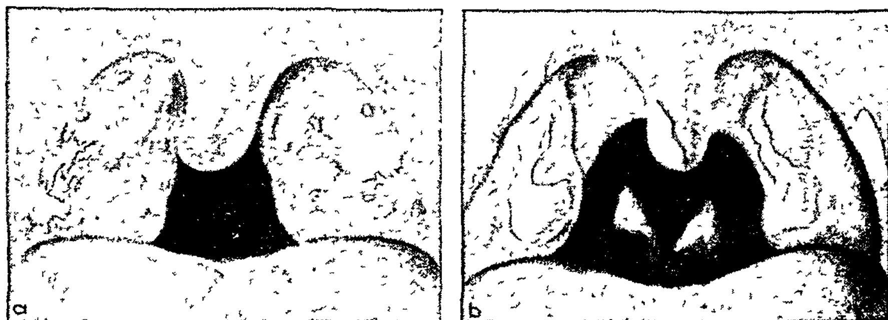


Fig 24. *A*, Acute follicular tonsillitis *B*, Membranous inflammation of tonsils (Boies, *Fundamentals of Otolaryngology*, courtesy of W B. Saunders Co)

cold has a multiple etiology in which lowered resistance, virus infection, and allergic phenomena all play a part. Secondary bacterial invasion occurs to some extent in all cases, and when this is by a highly pathogenic organism the morbidity may be severe.

It has been observed by many older dentists that acute upper respiratory infections often go hand in hand with pericoronitis, acute dento-alveolar abscess, and other oral infections. This suggests the role of lowered resistance in permitting previously existing chronic infections to flare into the acute stage.

The respiratory infections are common and serious, but, fortunately, with rest, fluids, and symptomatic treatment they usually abate in ten to fourteen days. It is generally felt that the use of antibiotics should be reserved for the more severe, specific complications such as otitis media, follicular tonsillitis, and suppurative sinusitis.

Recommended Precautions: Surgery should be deferred until recovery.

PNEUMONIA

The dentist doing oral surgery may be concerned with pneumonia in either of two ways. The first situation is associated with the *aspiration of foreign material*, usually during a general anesthetic. The offending substance may be blood, pus, a fragment of tooth, an entire tooth, or a portion of filling or other dental restoration. Cough, temperature, and other signs of pulmonary disease may be present for some time before the real cause is suspected. The process may follow the course of an atypical pneumonia or develop into a chronic lung abscess.

Recommended Precautions: All foreign material, liquid and solid, should be removed from the mouth at once during the course of any dental or oral surgical procedure. This activity is more or less automatic with the proper use of the headlight and suction aspirator.

The second type of pneumonia that may be seen is the *hypostatic* or *postoperative* variety. Elderly patients are particularly prone to develop this serious complication. Too much confidence should not be placed in antibiotics as a preventive measure, for the effect may be merely one of suppression of the infection during the period of therapy.

Recommended Precautions: Minimal sedation, early ambulation, judicious administration of fluids and electrolytes by the parenteral route, and rational use of antibiotics will all help to reduce the incidence of this serious development. Medical aid should be enlisted immediately upon the advent of cough, dyspnea, chest pain, or unexplained fever.

THE CHILDHOOD DISEASES

Scarlet fever, measles, chicken pox, and the other acute exanthemata and infectious diseases are attended by a prodromal period, in which the individual feels somewhat ill, loses his appetite, and runs a slight fever. Along with the general bodily aching there may be discomfort in the jaws or teeth, which will occasionally bring the patient to the dentist.

Recommended Precautions: Extractions should be deferred for children who have an unexplained fever, malaise, loss of appetite, slight cough, photophobia, or skin rash. The development of an acute infectious disease immediately following a tooth extraction will lead even the most broad-minded parent to feel that the dental procedure *caused* the illness!

During epidemics of *poliomyelitis* elective operations should be deferred for susceptible individuals.

Mumps, or acute epidemic parotitis, is the single member of this group which may introduce diagnostic confusion to the dentist or oral surgeon, being occasionally mistaken for cellulitis associated with an infected molar. As a rule the diagnosis of mumps is made without medical or dental assistance, on the basis of swelling, pain on moving the jaws or eating sour or spiced food, and the history of exposure to another case (Fig. 25).

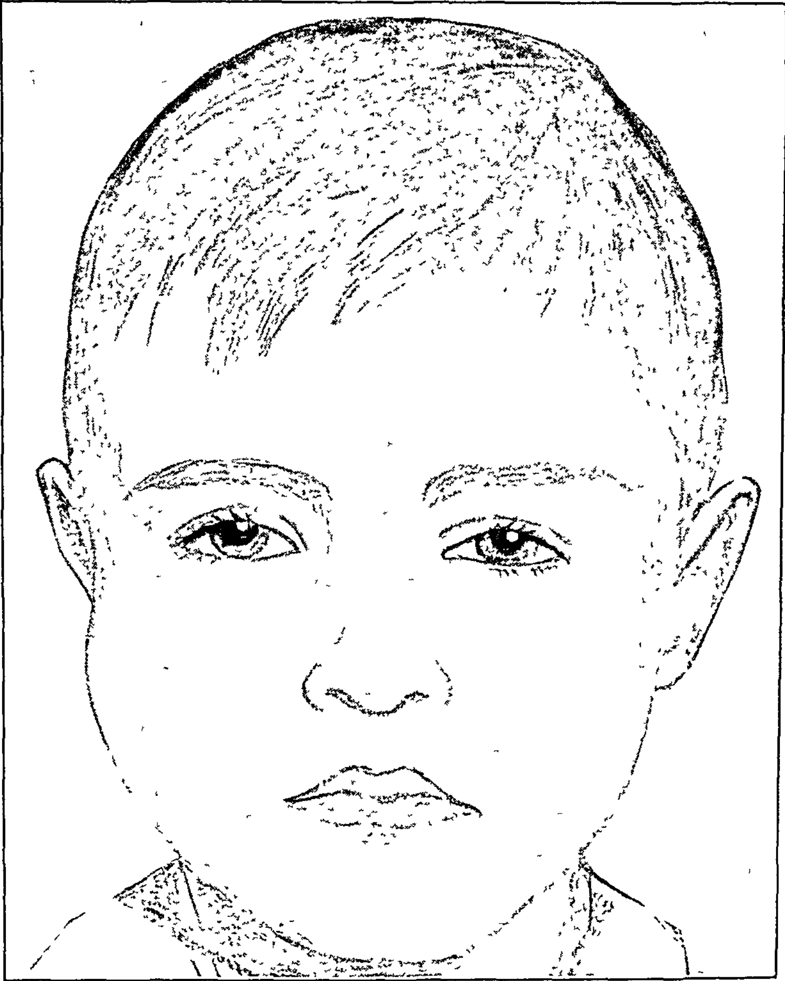


Fig 25 Mumps

DISEASES OF SPECIFIC ETIOLOGY

Syphilis

The presence of any peculiar lesion in the mouth or about a tooth should always arouse the intelligent curiosity of the dentist. A differential diagnosis between the "big three," syphilis, tuberculosis, and cancer, is not always easy, but the important thing to remember is to keep these diagnostic possibilities in mind at all times. All routine dental work should be deferred until a positive diagnosis has been made of the ulcer, lump, or other unusual pathological lesion.

The question of accidental infection of the operator from a patient known to have syphilis immediately suggests that rubber gloves should be worn for the performance of any type of dental procedure. Such a gesture borders on the superstitious when the facts are con-

sidered. Even before the days of penicillin, the open lesions of the leutic patient could be rendered noninfectious by a few injections of neoarsphenamine. Penicillin is even more effective in this regard, and frequently the first dose will be followed by the disappearance of all spirochetes from the chancre or secondary lesions as well as by a marked clinical improvement in the patient. Obviously, then, it is not the known case of syphilis, which is under treatment, that is to be feared, but the *unknown* and unidentified case with open oral lesions. If, therefore, one were to be consistent, he should wear rubber gloves for *all* oral surgical procedures on *all* patients.

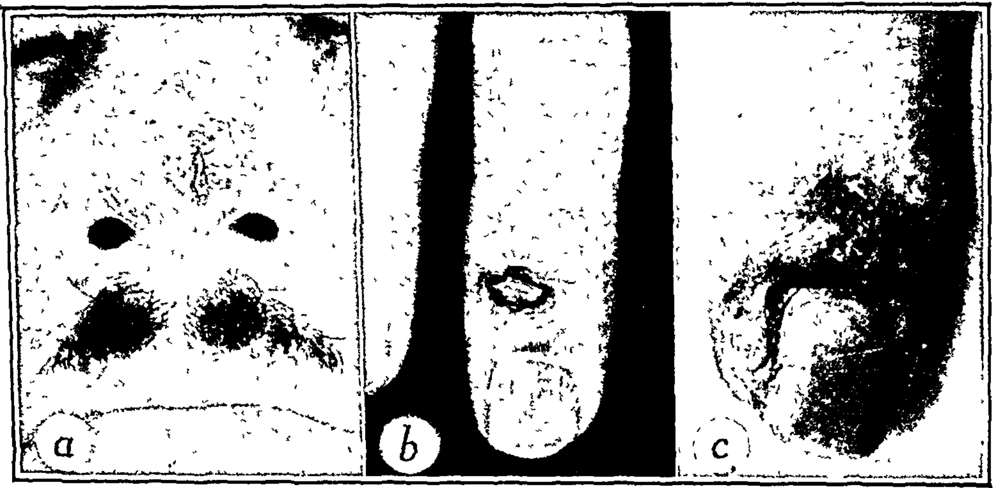


FIG 26 Extragenital chancres (Ormsby and Montgomery, *Diseases of the Skin*)

Gloves will not protect the hands of the operator from being accidentally pricked by contaminated surgical instruments. There are many other organisms indigenous to the oral cavity which can cause the loss of the hand, arm, or life of the operator if accidentally inoculated. Realistic precautions against this mishap, such as the use of the retractor rather than the finger when sharp instruments are nearby, become meaningful when considered in this light.

The syphilitic spirochete, as well as most pathogens, is highly sensitive to soap and water. If the routine for the care of the hands suggested in the chapter on asepsis and sterilization (p. 119) is faithfully followed, there is scant likelihood that the dentist will ever develop a digital chancre. *If* he should have this misfortune, he can rejoice in the knowledge that early syphilis, in or slightly past the primary stage, is virtually 100 per cent curable with a single dose of penicillin or one of the other antibiotics.

Recommended Precautions: No unusual precautions are indicated, providing no open lesions are present and the patient has received antiluetic therapy.

TUBERCULOSIS

The present generation is fortunate to be living in an age when the mortality from tuberculosis is steadily declining. There is no certain knowledge that the incidence of new cases has dropped proportionately, however. The situation with regard to protection of the dentist is somewhat different than with syphilis for a number of reasons. The latter is contracted by a single intimate contact with an open lesion of an individual with the disease. The transmission of tuberculosis is believed to result from massive invasion of large numbers of organisms through repeated exposure.

The undiagnosed patient with open tuberculosis is a menace not only to the dentist but to all members of society. Preventive measures now being conducted on a wide scale by many agencies cannot be too highly commended.

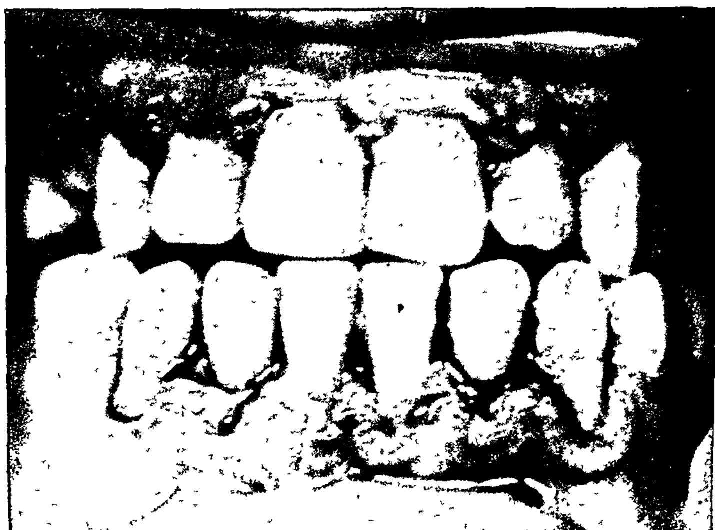


FIG 27 Acute Vincent's infection (By permission from *Textbook of Periodontia*, Miller, 1950, McGraw-Hill Book Co)

The dentist who routinely cares for tuberculous patients in an institution will follow the customary routines which have been adopted for that clinic. These usually consist of virtually an isolation technic. All instruments and linen are autoclaved after use, and all personnel wear masks and use a fresh surgical type gown for each patient.

Recommended Precautions: Complete isolation technic should be used for patients with known tuberculosis and positive sputum.

DIPHTHERIA

This very serious disease is maintained at a low incidence rate only by the persistent and energetic efforts of our public health agencies. It is completely preventable but difficult to cure. The dentist should always be on the alert for the characteristic dirty, gray membrane on pharynx, palate, or tonsils

Recommended Precautions: No dental care should be given. The patient should be placed under the care of a physician immediately.

Vincent's Infection

The cardinal signs of acute fusospirochetal stomatitis are: inflammation of the marginal gingivæ, pseudomembrane, bleeding of the gums, necrotic interdental septæ, pain, fetor, lymphadenopathy, and elevation of temperature. The crypt around a partially erupted lower third molar is a favorite spot for the lodgment of this infection.

Recommended Precautions: Absolutely no oral surgery should be performed until the acute infection has been controlled by antibiotics, scaling, and improved oral hygiene.

Acute Infective Hepatitis

This serious illness is transmitted by inoculation of the recipient with the virus through the blood of the host. Even a very faint trace of blood can carry over the infection. The virus is killed by boiling or steam under pressure, but not by cold sterilizing solutions.

Recommended Precautions: All needles for injection should be boiled or autoclaved.

THE COLLAGEN DISEASES

This group of diseases has evoked much interest recently because of the similarity of response to administration of ACTH and cortisone. *Rheumatic fever* is the commonest member of the group, though *lupus erythèmatosus*, *periarteritis nodosa*, and several other rare conditions also belong in this category. Until recently no treatment had been found which significantly altered the course of these diseases, and some of them were uniformly fatal.

Rheumatic fever is an affliction of children and young adults. It frequently imposes more than one attack upon its victim. The cause is not known, but it is believed that the patient develops antibodies against the alpha hemolytic streptococcus during the course of a throat infection first of all. With subsequent invasions of this organism an allergic or anaphylactic type of response occurs with the development of a substance which is harmful to the patient's tissues, particularly those containing collagen. Clinically, the synovial membrane and periarticular structures, the heart, and the brain are affected, giving the effects of painful, swollen joints, myocarditis, endocarditis, and chorea. At the termination of the attack the joints return to normal, but the heart suffers damage in at least 80 per cent of cases, in the form of scarring, retraction, or stenosis of its valves. This leads to impaired efficiency of the heart which may result in cardiac decompensation later in life. The defective valves must always be considered prone to the development of subacute bacterial endocarditis, should pathogenic bacteria become lodged upon them.

General Precautions: Surgery should be avoided during the acute stage of rheumatic fever. If the patient is under or has received ACTH or cortisone therapy, the precautions which have been outlined for such cases should be diligently applied. (See sections on Rheumatic Heart Disease, (p. 39) and Prevention of Bacteremia by Antibiotics, (p. 35).

CONDITIONS PECULIAR TO WOMEN

Pregnancy

It is not uncommon for women to discover the need for extractions at the time of pregnancy, for it is now standard medical practice for physicians to recommend a dental examination as a part of routine prenatal care. There is no evidence that the incidence or severity of caries is increased by the fetal needs for calcium. If the intake of this element is insufficient, minerals will be taken from the bones but not the teeth. However, whatever the motivation, preventive dental work to arrest the process of caries and to prevent pain is highly recommended!

Normal pregnancy does not introduce any specific contraindications to oral surgical procedures, but good judgment suggests that elective operations of a lengthy or highly traumatic nature should be deferred until after delivery. It is prudent to schedule oral surgical procedures so that they do not fall in the period when the patient would be menstruating if she were not pregnant, as the uterus is more irritable at those times.

General Precautions: Approval of the attending physician should be secured if any signs of toxemia of pregnancy are present such as edema of the ankles, sudden increase in weight, undue fatigue, or interference with vision. The more extensive elective procedures should be deferred until after delivery. Operations to relieve toothache, such as simple extraction, should be performed, preferably early in the pregnancy.

Menstruation

There is some clinical evidence indicating that women occasionally tend to bleed more freely from wounds during the menstrual period. Emotional instability or irritability are frequently present just before or during the menses.

Recommended Precautions: It is not necessary to go into the matter of the time of expected menstruation as a routine procedure. When the patient brings up the question, it is well to schedule the operation for a day that will fall between the periods. Premedication with barbiturates is indicated to counteract nervousness or anxiety.

Menopause

Women in the general age group of forty-three to fifty-five years may be experiencing menopausal symptoms such as emotional instability, hot flashes, anxiety, or other altered mental attitudes.

Recommended Precautions: Reference to the chapter on the Art of Practice (p. 367) is suggested for advice in the care of patients with unusual mental attitudes. Barbiturate premedication will materially assist in reducing apprehension.

ALCOHOLISM AND DRUG ADDICTION

Patients who are heavy users of alcohol or narcotics are notoriously difficult to handle under general anesthesia. The diagnosis of alcoholism may be made by the dentist's sense of smell, or surmised by the general behavior and attitude of the patient. Drug addicts virtually always show numerous tiny pigmented scars along the course of the veins of the arms from needle punctures. As the dentist does not usually examine his patients devoid of clothing this evidence will seldom be available, and the diagnosis may be missed.

Recommended Precautions: These people are poor candidates for general anesthesia, and may exhibit bizarre behavior under any type of treatment. They frequently fail to meet appointments, prevaricate, and are financially irresponsible.

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4

Instruments and Their Use

IN this chapter will be considered the correct manner of using the more important oral surgical instruments as well as their form, shape, design, and specifications. Chapter 7 will show how these bits of information about instrumentation are adapted to actual operations.

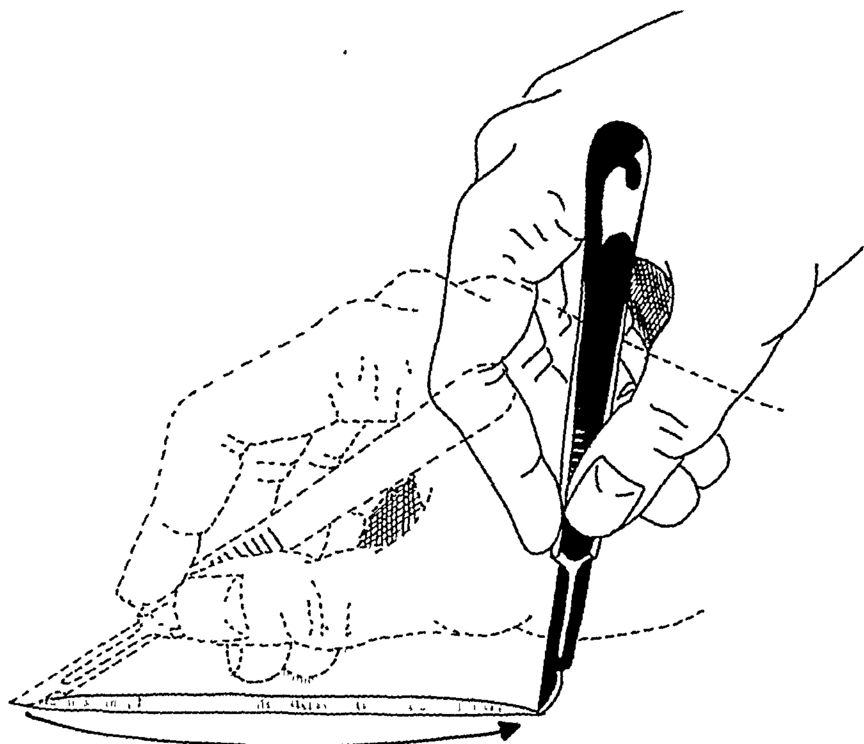


FIG 28 Making incision with No 15 blade

THE SCALPEL

FOR INCISING MARGINAL GINGIVA

1. The number 15 Bard Parker blade, or equal, is used.
2. The fourth and fifth finger tips are rested on a solid base. The instrument is held like a fountain pen.
3. The curved portion of the blade is placed on the tissue surface, firm pressure made downward, and the blade drawn with a steady stroke for the desired distance.

4. Even pressure is made throughout the entire incision; at the end of the stroke the handle is raised, finishing with the tip of the blade.

5. The beginner tends to use the scalpel and periosteal elevator alternately for a total of five or six exchanges. This results in more trauma and lost time. It must be determined that the incision is down to bone before the scalpel is laid down.

For Incising Loose Tissues, Such as Mucosa of Cheek

1. The number 15 Bard Parker blade, or equal, is used.

2. The tissue is placed on a definite *stretch* by the retractor in the left hand, or with a gauze square to aid the intra-oral finger to grasp the cheek or lip without slipping.

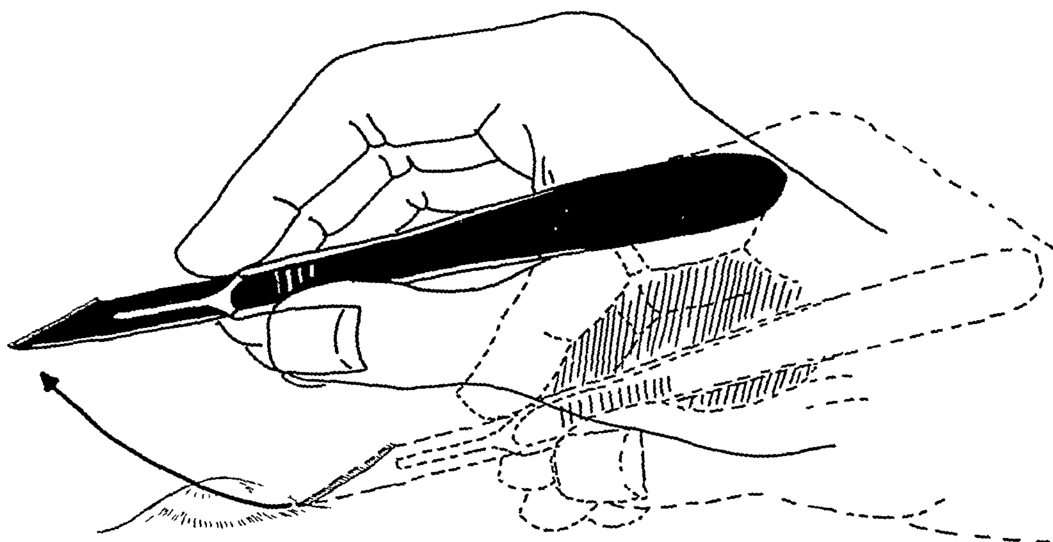


Fig 29 Lancing abscess with No 11 blade

3. The line of the incision is visualized mentally.

4. The complete incision is made boldly, with firm, steady pressure, finishing up with the point of the blade. The cut should extend into the submucosa.

5. There should be no stopping midway through the incision to clamp bleeders. They are controlled after the scalpel has performed its function.

To Incise Well-localized Abscess

1. The number 11 Bard Parker blade, or equal, is used.

2. The point of the blade is placed at the edge of the swelling, directed at the center, with the cutting edge *up*.

3. *One* sweeping stroke, *in*, *up*, and *out*, is made. The incision must extend well into the pocket of pus on the first attempt, but not too deep, so that large vessels might be unnecessarily severed.

4. If performed in the manner described, incision of pointing gingival abscesses may be done without anesthesia, for the pain,

which is of very brief duration, is not perceived until the act is accomplished.

THE PERIOSTEAL ELEVATOR

Specifications

The number 7 wax spatula serves very well.

Anatomical Considerations

The labial and buccal mucoperiosteum is tightly attached to alveolar bone at the gingival margin. Farther apically it is more loosely attached and a plane of cleavage exists.

The palatal mucoperiosteum is *all* tightly bound down.

The mandibular lingual mucoperiosteum is thin and must be raised with great care to avoid tearing.

Pathological Considerations

Previous or chronic inflammation (draining sinus tracts and periodontal pockets) produce heavy fibrosis and tight binding of soft tissues to the bone.

To Raise Labial or Buccal Mucoperiosteal Flap

Any of three methods may be used, at the election of the operator:

The Push Stroke:

1. The wide end of the instrument is kept at a 45 degree angle to the surface Repeated shovelling thrusts are made.
2. *All* fibers that would bind the flap to bone must be severed, by sliding the instrument on bare bone.
3. The flap will split and tear if excessive, bursting force is applied to a tightly bound down edge of mucoperiosteum. Advantage should be taken of the less tightly attached portion, away from the free gum margin, in getting the flap started. It is usually well to do easy things first, when raising flaps, so that the plane of cleavage will be readily established.
4. The retractor, in the operator's left hand, raises the edge of the flap as soon as possible, so that the uncut fibers may be seen and severed under direct vision By putting fibers on a stretch it makes them easier to sever from bone.

The Pull Stroke:

1. Often the flap can be peeled from the bone somewhat as the skin of a tangerine is removed from the fruit.
2. The wide blade of the spatula is used to draw the flap toward the operator.
3. This technic is often useful in raising flaps when alveolectomy is being performed after the teeth have been extracted, either at the the same sitting or a week or two afterward.

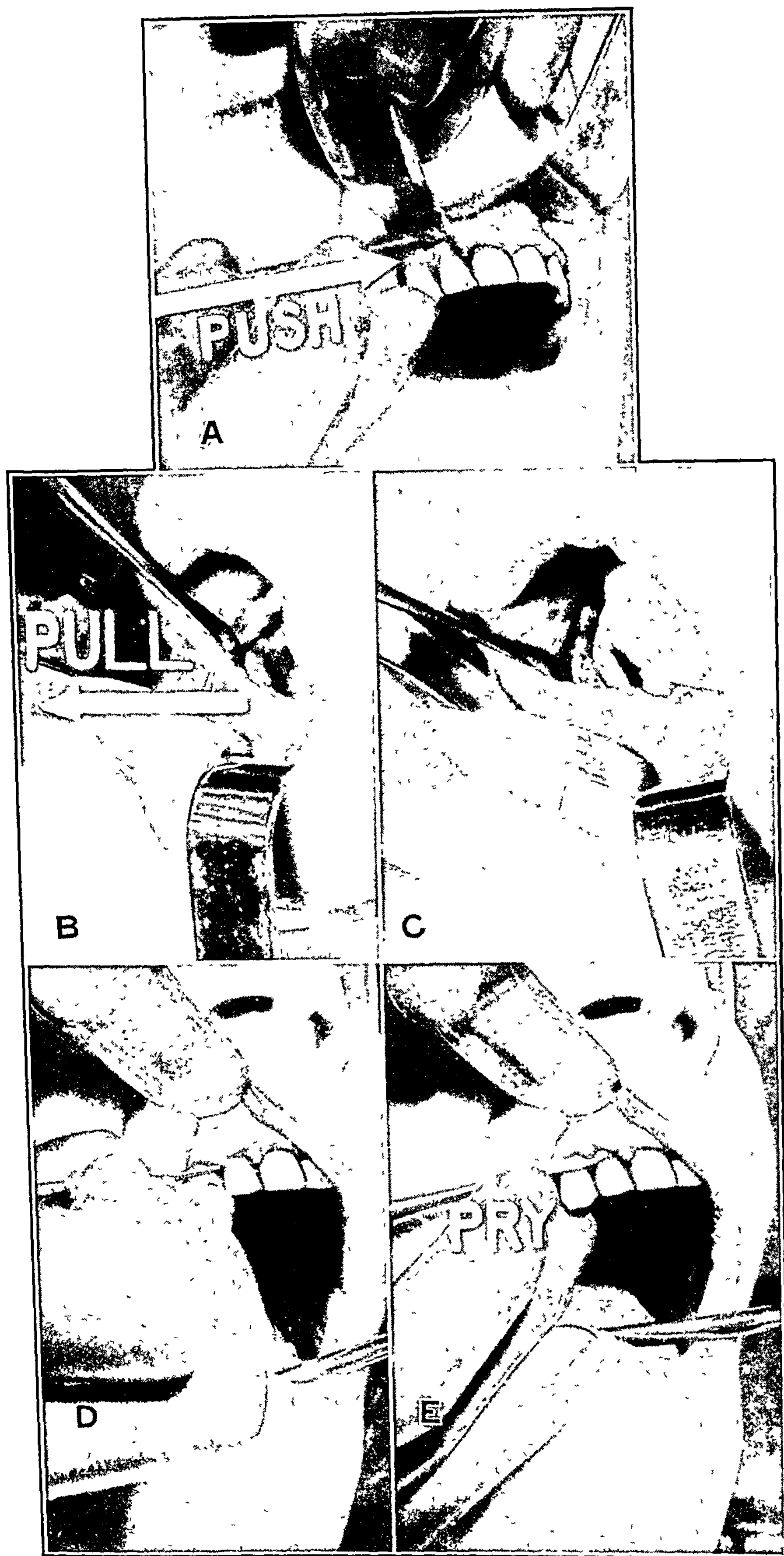


FIG. 30 Three methods of raising the flap with the No 7 wax spatula. *A*, the PUSH stroke; *B* and *C*, the PULL stroke; *D* and *E*, the PRY stroke.

The Pry Stroke:

1. The interdental papillæ are tightly bound down but are also thick and strong. The small end of the spatula is used to detach them from bone.

2. The point of the instrument is inserted firmly under the triangular mass of tissue, and, by using the adjacent tooth as a fulcrum, the tissue is pried away from its bed. The interdental septum will usually break away readily.

3. Since this pad of tissue is thick it will not split. Raising one or more papillæ will reveal the bony plateau beneath so that further raising of the flap may be accomplished easily, without laceration of the thinner mucosa lying over the center of the tooth.

With effective use of the periosteal elevator, retractor, light, and aspirator, no more than twenty seconds should be required to raise a flap.

THE RETRACTOR

Specifications

1. University of Minnesota hand-fitting cheek and flap retractor.* A metal ribbon type with smooth blade designed to gently hold back the cheek or mucoperiosteal flap.

2. Alternate choice· Austin right angle flap retractor with two semi-sharp teeth at the end.

Advantages of Retractor over Finger, for Flap Retraction

1. The retractor can be boiled and is thus more sterile than the finger.

2. The retractor is safer. Fingers are kept away from the bur, chisel, or sharp-pointed elevator.

3. The retractor is less bulky, provides more room in the small operative field.

4. The retractor is more efficient, holds the flap back better, results in less slipping (which produces trauma) of the flap.

For Retracting Lip or Cheek, for Examination or Postoperative Treatment

1. The retractor is held in the operator's left hand. For use on the left side of the mouth the operator's arm encircles the patient's head.

2. The blade of the retractor draws the cheek or lip *away* from the alveolar ridge, putting the former on a stretch.

3. Resting the end of the retractor on the gingiva pinches, hurts, and traumatizes the tissue.

For Retracting the Mucoperiosteal Flap

1. The retractor is held in the operator's left hand (except at the time of tying knots in suture, when the assistant automatically takes it.)

* Obtainable from Professional Dental and Mfg Co, 5043 N Damen Ave, Chicago

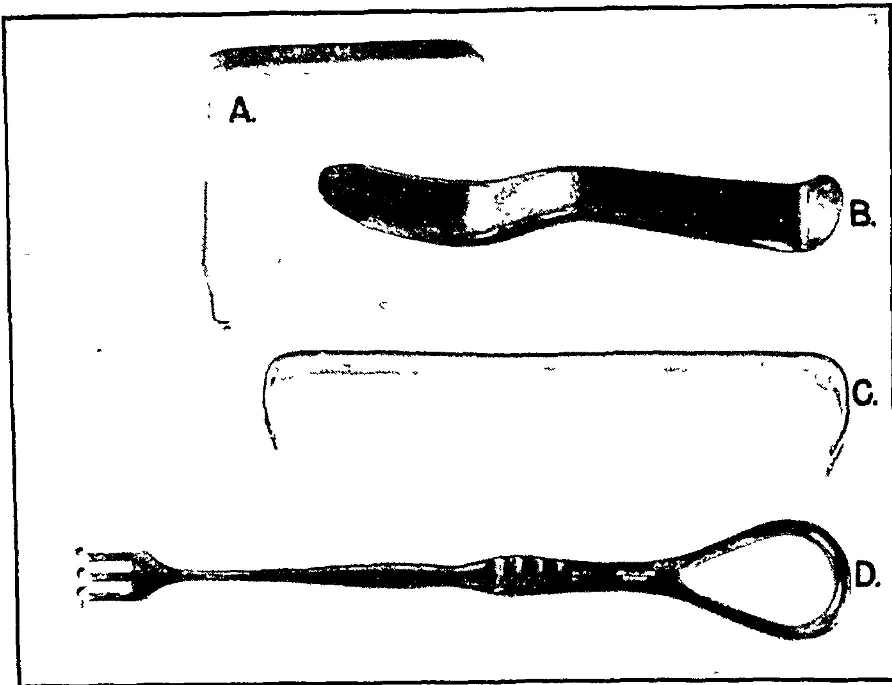


FIG 31 Retractors useful in oral surgery.
A, Austin, *B*, University of Minnesota type, *C*, ribbon; *D*, catspaw.

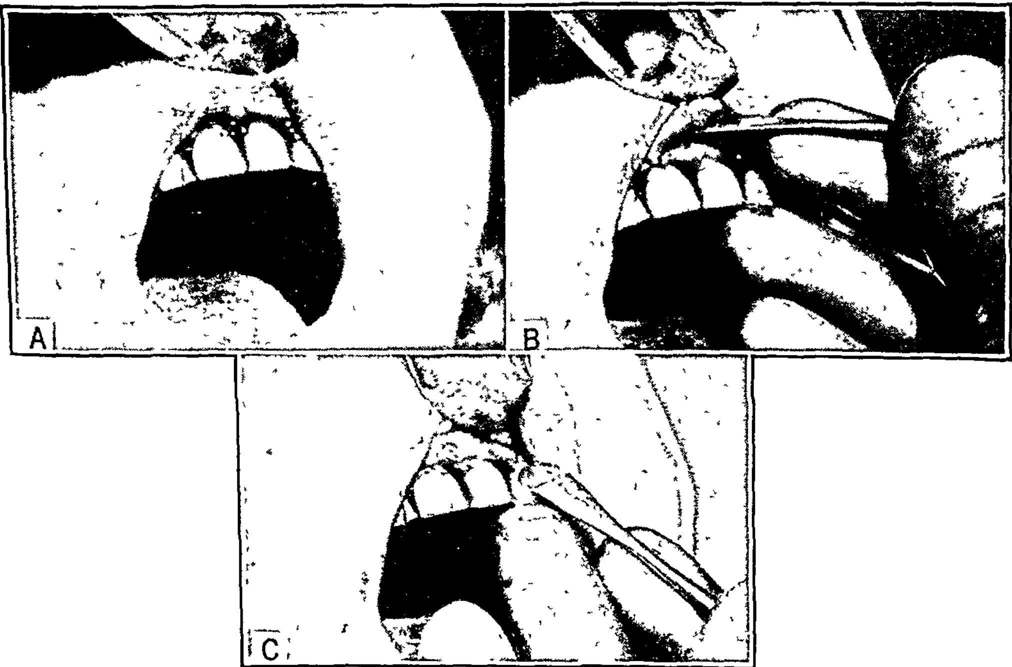


FIG. 32. Steps required to place retractor beneath flap without trauma *A*, lip or cheek raised with retractor, *B*, flap raised with any instrument in right hand; *C*, retractor put carefully to place, resting on bare bone.

2. The operator's left wrist or forearm rests lightly on the patient's head or forehead, to steady the instrument and prevent undue arm fatigue.

3. The retractor is placed in position in three steps:

(*a*) The cheek or lip is raised with the retractor.

(*b*) The flap is gently raised with whatever instrument is in the right hand.

(*c*) Then the tip of the retractor is put to place and pressed firmly against bone, to prevent slipping. The retractor is *never* rested on the reflected base of the flap, as this would thrombose nutrient vessels to the flap.

4. The retractor performs two important functions: it draws the soft tissues aside, permitting an unobstructed view of the hard tissues beneath, and it holds the delicate soft tissues out of the way, protecting them from trauma from the bur, chisel, or elevator.

THE SURGICAL BUR

Specifications

The bur used is the number 560 cross cut fissure type, on which a chisel point has been ground to permit end cutting as well as side cutting. A bur is discarded after use on one operation. Sharp instruments are always safest, can be used with a lighter touch. The straight handpiece is used whenever possible, so as to have minimal bulk of instrument in the operative field. Handpieces are sterilized in hot oil between patients.

General Principles

1. As a rule, the chisel is used for upper jaw and the drill for lower jaw work. The mandible bounces and springs away from mallet blows. Also, mandibular bone is harder, needs the advantage given by the bur.

2. The revolving bur is never used free-handed. The tips of the fourth and fifth fingers are rested *very heavily* on nearby teeth or alveolus. If the teeth are sharp the fingers are protected with a folded gauze square.

3. The revolving bur is *never* used without an intermittent stream of water or saline being played upon it by the assistant. At the same time, the suction aspirator tip must be held at a low point nearby, to pick up waste water and débris.

4. Periosteum and other soft tissues must be firmly held away from the revolving bur or they will catch and wrap around it with mutilating effect.

5. It is often best to run the bur at a constant, high speed, with a pumping action to permit the coolant to reach frequently the cutting end of the bur.

Indications for Use

1. To remove bone.
2. To cut into and divide tooth substance for ease in removal.

To Remove Bone

1. *To Expose a Buried Tooth or Root Fragment.* (*a*) A careful estimation is made of the probable location with regard to nearby landmarks visible on the radiograph and in the mouth.

(*b*) A circle of drill holes is made over this area, even *larger* than would be thought necessary. The bur should cut just through the cortical plate.

(*c*) The drill holes are connected by inserting the tip of the bur and pulling *outward* through each bridge separately. When this method of trephining is used, there will be little excuse for the bur to "travel" into soft tissue, producing mutilation.

(*d*) The disc of bone is pried out as one piece.

(*e*) Further entry into the bone is done with the hand chisel, used in a scooping manner, when a small root tip is being sought. If an entire tooth is being exposed, the bur may be used to "clean" it with light brushing strokes.

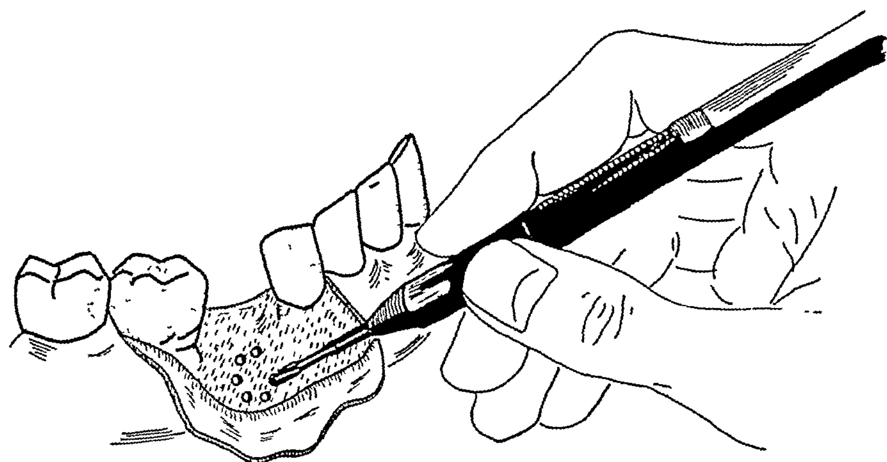


Fig. 33 Method of gaining entry to mandible for removal of root fragment; circle of drill holes being made.

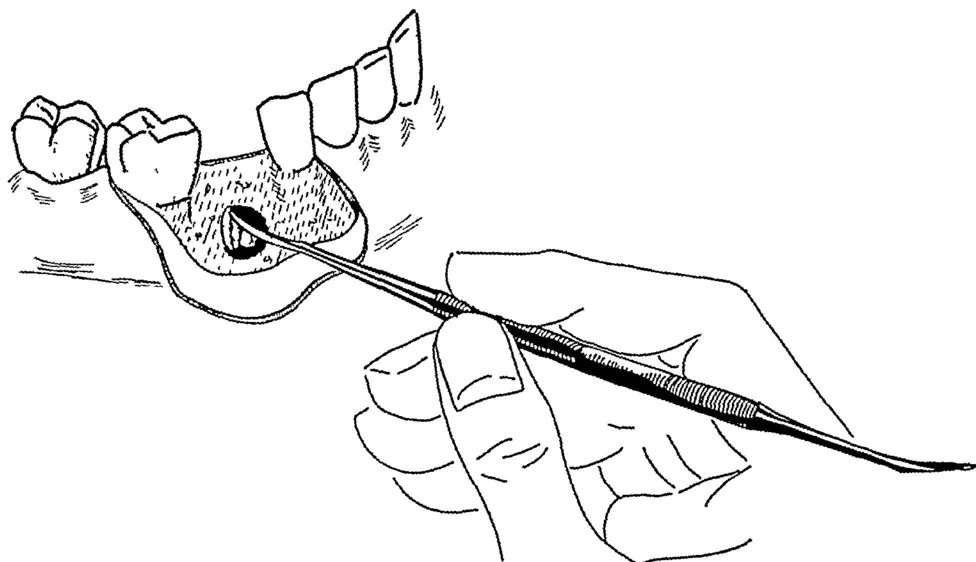


Fig. 34 Root revealed, after circle of drill holes has been completed and disc of bone pried up.

2. *To Release Hypercementosed, Curved, or Fractured Root.* (*a*) If the safety of adjacent teeth is not a consideration, a circle of drill holes is made on the buccal, and the disc of bone removed. This provides prompt, wide access and removal of resistance. Bone is then cleaned from the mesial and distal surfaces of the root, with the bur resting lightly on the root surface for guidance.

(*b*) When adjacent teeth are to be retained, or when working near the mental foramen, the bony wound is opened up more cautiously by drilling a single hole in a spot known to be over the tooth to be removed, then the exposure extended occlusally, mesially, and distally, until the excavation reveals the exact location of the root. Undercuts or areas of ankylosis which have prevented removal are cut away.

To Cut into and Divide Tooth Substance for Ease in Removal

1. The drill is passed straight into the center of the root, proceeding to what is estimated to be four-fifths of the way through. The hand piece is used with a pumping action to permit the water to cool and clean the bur.
2. Lateral pressure is then made toward the mesial, cutting nearly through.
3. Lateral pressure is then made toward the distal, cutting nearly through.
4 Into this slot a screwdriver-shaped instrument is inserted and turned, breaking off the fragment.

THE MALLET AND CHISEL

General Principles

Basically, the chisel is used for upper jaw and the drill for lower jaw work. The chisel works well for maxillary bone removal because the bone is more porous and the entire head acts as a counter mass to receive the mallet blows. Use of the chisel obviates the need for heavy use of water and aspirator, as with bur work.

Indications for Use

1. For removal of bone.
2. For splitting teeth.

Specifications

1. Chisels must always be razor sharp, with an acute bevel.
2. The single bevel type is used for cutting bone.
3. The bi-bevel type is used for splitting teeth.
4. Any heavy headed small surgical mallet that can be readily sterilized is satisfactory.

For Removal of Bone

1. It must be made certain that the flap is peeled back well beyond the point to which bone is to be removed.

2. The chisel is placed nearly in line with the long axis of the tooth. (To pound at right angles is disagreeable to the patient and chips into the tooth.) The bevel may be either up or down, at the discretion of the operator, but the chisel should not be allowed to bind.

3. With either hand pressure or by use of the mallet, bone is *shaved* off. The mallet blows should be continuous: tat-tat-tat-tat, in fairly rapid sequence, and hard enough to effect rapid bone removal.

4. The anatomy of the root should be unchanged. The root should be *dissected out.*

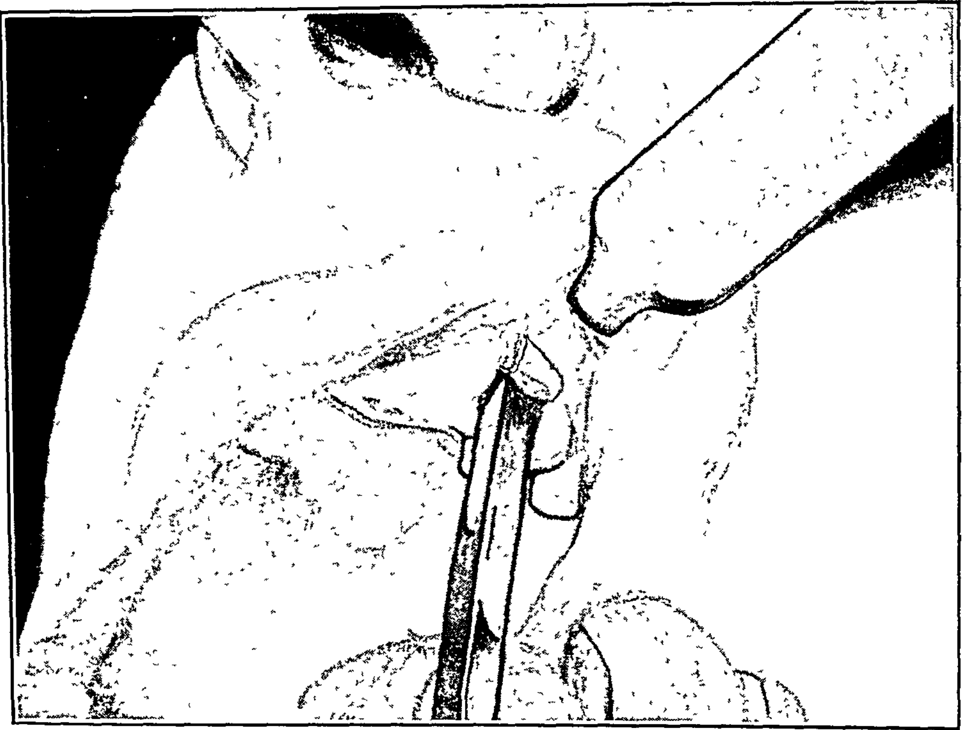


FIG. 35. Use of chisel to shave bone from root of upper tooth.

5. All bone is cleaned off of the buccal (or labial) surface of the root way up to the apex and also around to the mesial and distal, to remove undercuts.

6. The root is removed with the inclined plane or sharp-pointed elevator. (The chisel, already in hand, can frequently be used as the sharp-pointed elevator.)

FOR SPLITTING TEETH

1. For this technic to succeed, the tooth must be solidly in its socket. Preferably, there should be some preliminary bone removal so that the sections can fall apart when the split is made.

2. When a lower third molar is to be split and the patient is under local anesthesia, it is a good plan to have him bring up his hand,

2. *To Release Hypercementosed, Curved, or Fractured Root.* (*a*) If the safety of adjacent teeth is not a consideration, a circle of drill holes is made on the buccal, and the disc of bone removed. This provides prompt, wide access and removal of resistance. Bone is then cleaned from the mesial and distal surfaces of the root, with the bur resting lightly on the root surface for guidance.

(*b*) When adjacent teeth are to be retained, or when working near the mental foramen, the bony wound is opened up more cautiously by drilling a single hole in a spot known to be over the tooth to be removed, then the exposure extended occlusally, mesially, and distally, until the excavation reveals the exact location of the root. Undercuts or areas of ankylosis which have prevented removal are cut away.

To Cut into and Divide Tooth Substance for Ease in Removal

1. The drill is passed straight into the center of the root, proceeding to what is estimated to be four-fifths of the way through. The hand piece is used with a pumping action to permit the water to cool and clean the bur.
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4. Into this slot a screwdriver-shaped instrument is inserted and turned, breaking off the fragment.

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3. The bi-bevel type is used for splitting teeth.
4. Any heavy headed small surgical mallet that can be readily sterilized is satisfactory.

For Removal of Bone

1. It must be made certain that the flap is peeled back well beyond the point to which bone is to be removed.

Principles of Physics Involved

1. Displacement effect. Two objects cannot occupy the same place at the same time. The intent is to cause the metal point of the instrument to occupy the socket instead of the tooth.

2. Lever effect. When the end of the elevator has entered *well into* the socket a slight lever action will have extreme expulsive effect. It *lifts* the root out of its bed.

To Remove Root Where There Is No Adjacent Empty Socket

1. The tip of the elevator is placed against the neck of the tooth or root, in line with its long axis.

2. With firmly applied pressure an attempt is made to slide the blade up alongside the root *to the apex*. Worming, slightly prying, but always intruding forces should be employed.

3. If no seat for entrance of the elevator can be found, the surgical bur may be used to provide a point of entrance.

4. The end of the instrument must be carried to the apex of the socket so the root will not fall back into its bed. The operation must *follow through*.

5. Without delay, the root should be recovered with the index finger, removed from the mouth, and placed on the table.

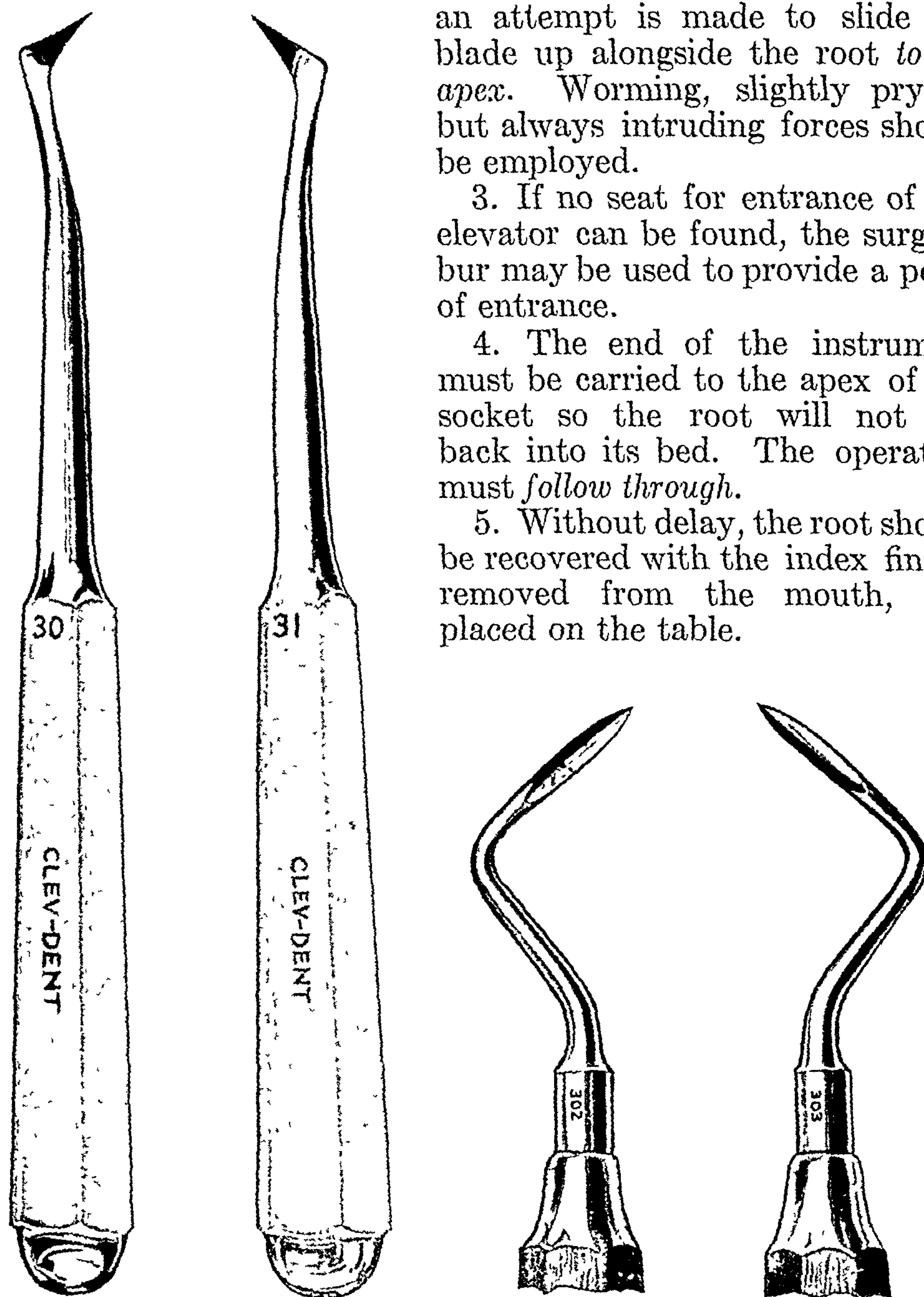


Fig. 36. Types of sharp pointed elevators. (Cleveland Dental Mfg Co.)

beneath the drapes, and support the angle of the mandible with the heel of the hand.

3. The cutting edge of the chisel is placed in a well-developed groove or fissure and held firmly in place.

4. The patient should be cautioned that there will be a sharp jar.

5. A single strong, sharp blow is made with the mallet. The handle should be held at the end for best results.

6. The chisel is placed in the crevice thus created and, with caution, slowly but resolutely forced deeper and deeper, so that the free fragment is pried loose and extruded.

7. If the tooth does not split after one or two tries it is well to abandon this method in favor of the bur technic, for the enamel may be gnarled and further efforts would involve unwarranted trauma.

THE SHARP-POINTED ELEVATOR

Specifications

Any of several stone-sharpened, pointed, single-bladed instruments designed to remove a root by biting into the cementum and dragging it from its socket.

To Remove Root Fragment Adjacent to an Empty Socket

1. The handle of the instrument is grasped firmly in the palm.
2. The fulcrum, rest, or axis for turning is secured on the alveolar process, usually on the edge of an already empty socket.
3. The point of the elevator is brought to bear on the cementum, by biting through a bony septum if necessary, to reach the root.
4. The root is lifted or dragged from its socket as the non-slipping point retains its bite in the cementum. The point engages the tooth in the same manner as an ice tongs bites into a cake of ice.

Important Hints

1. The point of the elevator should be sunk into the root *as near the apex as possible*, for best results.
2. The path of force should be *in line with the long axis* of the tooth. If the first application of force does not succeed, a slightly different path should be tried.
3. The point of the instrument must be razor-sharp, able to raise a shaving from the thumb nail when drawn across it.

THE INCLINED PLANE ELEVATOR

Specifications

Any of several unsharpened, single bladed instruments with wedge-shaped working end. The end may be in line with the shaft (straight elevator), at a slight angle (LeCluse), or at nearly a right angle (upper third molar elevator.)

To Remove Unerupted or Partially Erupted Teeth

(See section on Impacted Tooth Removal, p. 163.)

THE RONGEUR FORCEPS

Specifications

Any of several forceps-like instruments designed to cut bone by their nipping, biting, or shearing action. Two types are used, the round-nosed rongeur and the side cutting bone forceps.

Round-nosed Rongeur—Indications for Use

1. To open up the side of a socket to expose a fractured root tip.
2. To enlarge a window into a cyst or the antrum, by bone biting action.

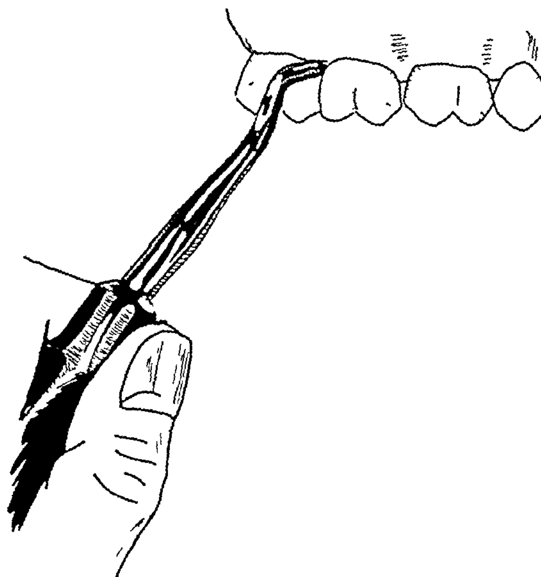


Fig 40. Placement of upper third molar inclined plane elevator.

3. To remove or smooth bone in alveolectomy (not as effective for this purpose as the side cutting bone forceps. When a point of bone is nipped off with the tips of the beaks, two small points are left. The resulting surface has a nutmeg-grater feel.)
4. To grasp and securely hold tough, fibrous tissues that are to be drawn away from bone (pericoronal sac, cystic membranes, or scar tissue masses.) The foil carrier or frail tissue forceps are not suitable for this purpose.
5. To extract a portion of a tooth from a deep bony wound when a rotation and lifting movement is required.

Side Cutting Bone Forceps—Indications for Use

1. To remove bone or smooth bone in alveolectomy. It is excellent for this purpose, surpassing the round-nosed rongeur due to its planing action, the ease with which it cuts through bone, and the ease with which it is cleaned of débris after each cutting stroke.

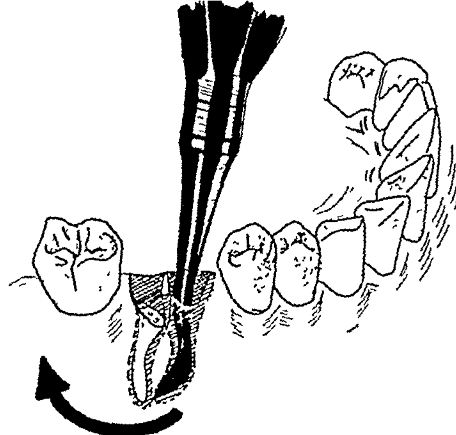


Fig. 37. Use of sharp pointed elevator for removal of lower molar root.

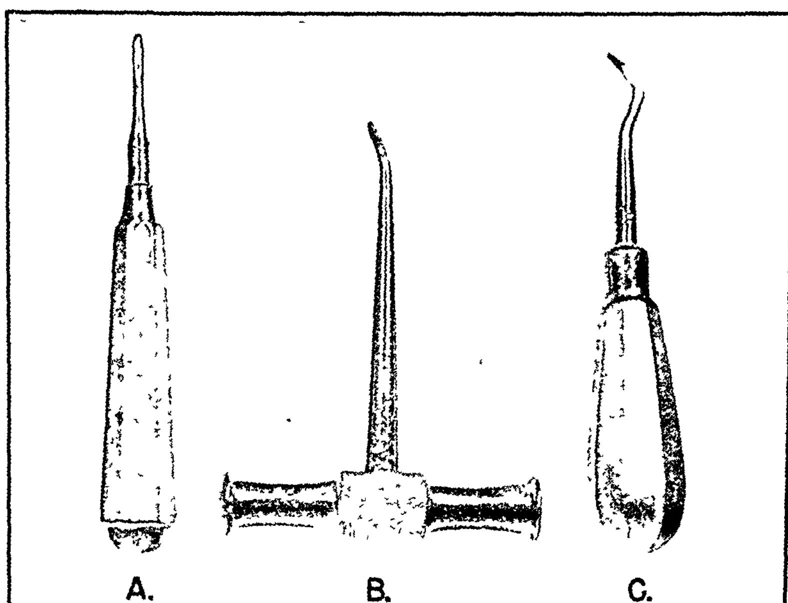


Fig 38. Types of inclined plane elevators *A*, straight type, *B*, LeCluse type with crossbar handle, *C*, upper third molar type

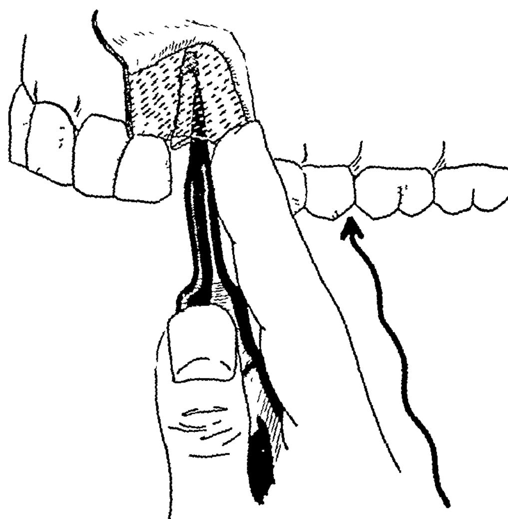


Fig. 39. Use of straight inclined plane elevator on upper cuspid root.

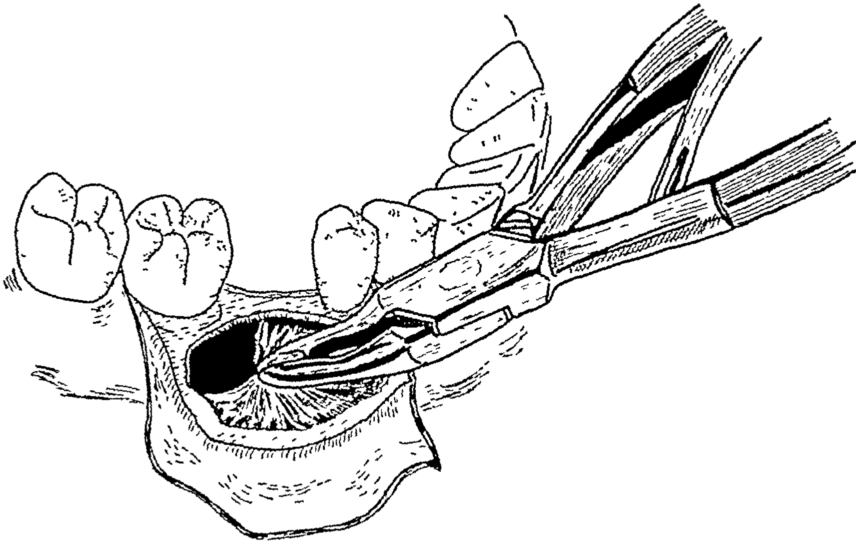


FIG. 42. One method of removing tough, adherent membranes such as cyst linings.

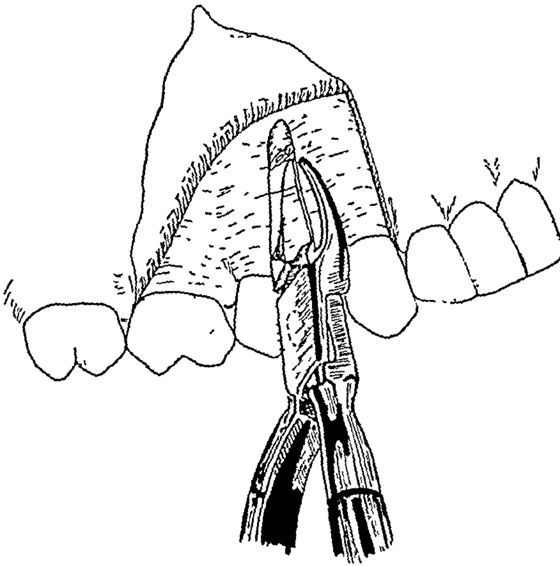


FIG. 43. Method of opening up side of socket with side cutting bone forceps.

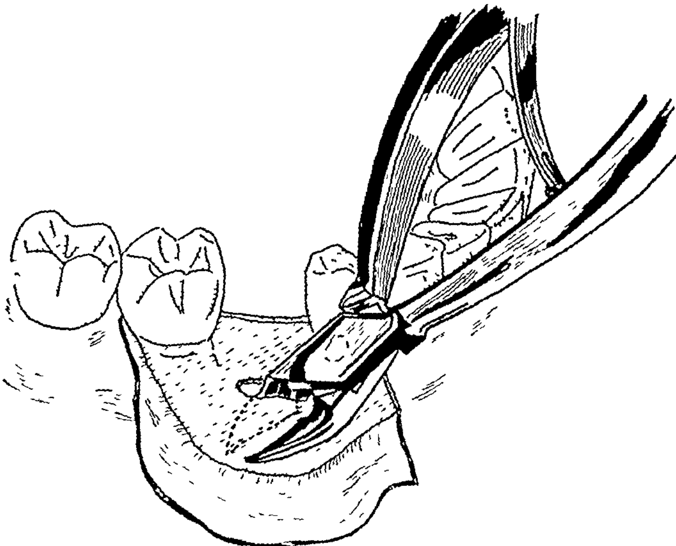


FIG. 44. Gaining access to cyst by making window with side cutting bone forceps.

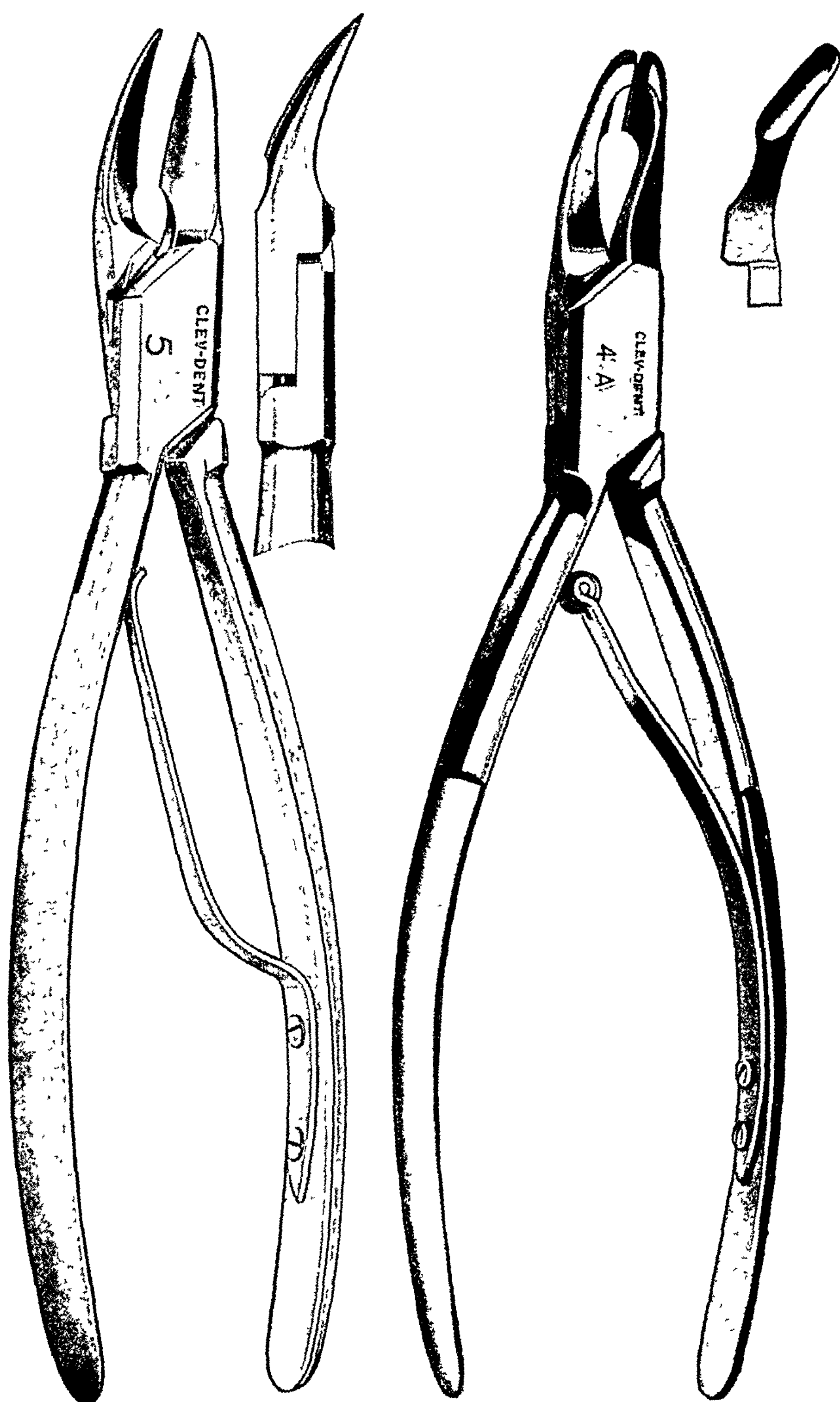


Fig. 41. Side cutting bone forceps and blunt nosed rongeur (Cleveland Dental Mfg Co)

Comparison of Bone Cutting Instruments for Ridge Trimming in Alveolectomy

Rongeur. When cutting is done with the side of the beaks it acts like a plane and will not cut too deeply. The resulting surface is virtually finished and needs little or no smoothing with the rasp. The action is simple and rapid. The instrument is readily wiped clean in one motion by the gauze square in the assistant's hand.

Chisel. Two instruments are required—the mallet and the chisel. The chisel has poor control of depth of penetration. When indicated, it can remove a large mass of bone quickly.

Rasp. This instrument will not cut too deeply by accident, but is slow, and difficult to clean after it becomes filled with bony débris.

THE RASP OR BONE FILE

Indications for Use

1. For final smoothing of bone in ridge trimming procedures, after gross removal has been accomplished with the rongeur or side cutting bone forceps. Its use may be compared to that of sandpaper in carpentry.
2. For bone smoothing in sites that cannot be conveniently reached with the rongeur.

Mode of Use

1. Long, sweeping strokes are used, with a carry through, ending out in a safe area. The instrument cuts on the *pull* stroke.
2. Cleaning is accomplished by laying the blade on the assistant's sponge, then making one lateral motion. Bone dust will be left on the sponge.

THE GILMORE PROBE

Specifications

A slender, stiff, tempered instrument with a slightly curved point, somewhat heavier than a dental explorer.

Indications for Use

1. For teasing out small root tips, or wiggling them to visually outline their size, shape, and position.
2. For exploring structures in the depth of a wound such as the inferior alveolar nerve or the lining membrane of the antrum. It is delicate and may be used without producing trauma, when held in the fountain pen grasp.
3. For blunt dissection, to separate the capsule of a cyst or benign tumor from the surrounding normal tissue, when the two are intimately fused. The probe is used in a lateral, scratching manner, thus separating a few fibers at a time.

Contraindications for Use

1. It is *not* used for heavy elevation of root fragments, as it will break. Elevators should be used for large roots.

2. To open up the side of a socket to expose a fractured root tip.
3. To enlarge a window into a cyst or the antrum, by scissors action.
4. Occasionally to trim soft tissue such as fibrous tuberosities or interdental papillæ prior to wound closure.

To Remove Bone in Alveolectomy with Rongeur Forceps or Side Cutting Bone Forceps

1. The flap is held well back by the retractor in the operator's left hand.
2. The assistant has an open 3 × 3 inch gauze square in her left hand.

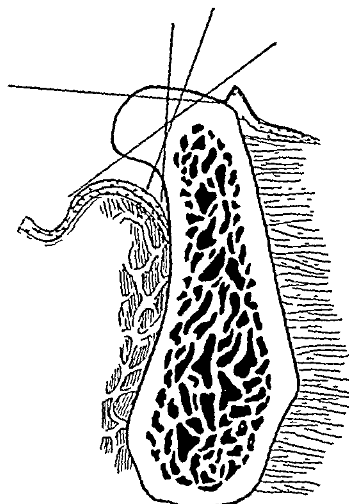


Fig 45 Diagram illustrating that several straight bone cuts with side cutting bone forceps will produce curved surface of alveolar ridge.

3. With the rongeur in the right hand, the operator takes bites of bone and after each fragment has been detached points the opened beaks toward the assistant without taking his eyes or light from the operative field. The assistant wipes the beaks clean, using the gauze square, with a single milking action.
4. This procedure is repeated in rhythmic fashion so that successive bites are removed, steadily contouring the bone to the desired shape. All action is automatic except for the sculpturing of the alveolar ridge which receives the full attention of the operator. The bone fragments quickly pass from the ridge, to the rongeur, then to the gauze square, in systematic fashion.
5. Particularly with the side cutting bone forceps, when the cutting strokes are all made tangent to the desired convex ridge form, a curved surface will result, even though each cut has been on a straight line.

Caution!

Both of these instruments can cause brutal crushing injuries of the lips, cheeks, tongue, or flap. All soft tissues should be drawn well away from the working parts of the rongeurs.

2. It should *not* be used for cleaning the suction aspirator tip as it may break. The beak of the foil carrier or an iron wire pick will serve better.

THE DOUBLE-ENDED CURET

Indications for Use

1. For enucleating granulomas, soft tissue tumors lying within bone, cysts, or other membranes.
2. For removal of bone chips from sockets and alveolectomy wounds.

To Enucleate Granulomas or Cysts

1. By *push* strokes the mass is peeled from each of the four walls of its bony bed. They should be considered as north, south, east, and west walls, and sufficient time devoted to each of the four. Each end of the curet will clean two walls. The blade should be inserted so that the concave side faces the outside wall, so that it will curve under the overhanging margin of bone.
2. Lastly, the blade is placed beneath the mass and the tissue lifted out from the bony cavity as with a spoon.

THE SUTURE, NEEDLE, AND NEEDLE HOLDER

Specifications

Suture. 1. For suturing oral mucosa: Deknatel silk, type B, 3-0, cut in 14 inch lengths, or Ethicon silk of the same size, cut to the same length.

These materials are treated to be serum proof and are braided, to resist coiling and snarling. When purchased in 25-foot spools, the cost is around two cents per foot. Nonabsorbable suture material has uniform tensile strength whether wet or dry, lending itself well to the time saving technic of instrument tying of knots. Being black, the stitches are easily seen when the patient returns for their removal. One of the reasons for using nonabsorbable material is to bring the patient back for the all important postoperative "look."

2. For tying bleeders or closing muscle or fascia: Pyoktanin catgut, plain, type A, 000, or chromic or plain catgut, size 000.

Needle. 1. Cutting edge for suturing oral mucosa: Anchor Brand 1822—18 (large) or 1822—20 (small), or Hu-Friedy three-eighths circle, size 18 or 20.

2. Round (noncutting) for stitch tying or closing muscle or fascia: Anchor Brand 1833, number 2 or 3.

Needle Holder. For all purposes, Hegar-Mayo, 6 inches long.

USE OF NONABSORBABLE SUTURE MATERIAL

Preparation for Suturing Oral Mucosa

1. Needles are threaded in advance. A 14-inch strand of silk is passed through the eye of the needle and a simple overhand knot

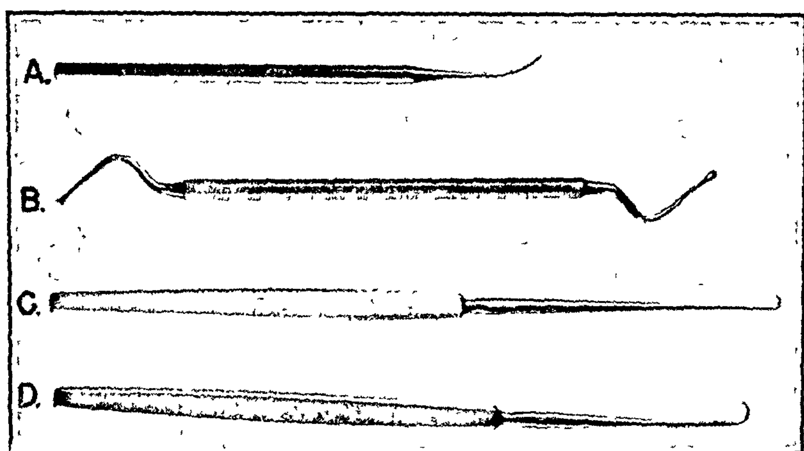


FIG. 46. *A*, Gilmore probe; *B*, double ended curet; *C* and *D*, two sizes of traction hooks.

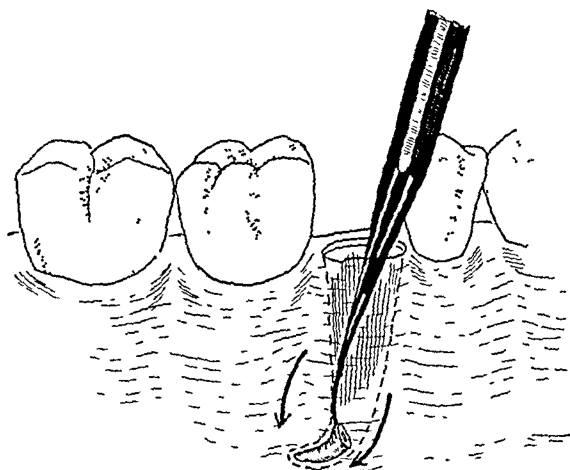


FIG. 47. Method of teasing out loosened root tip with Gilmore probe.

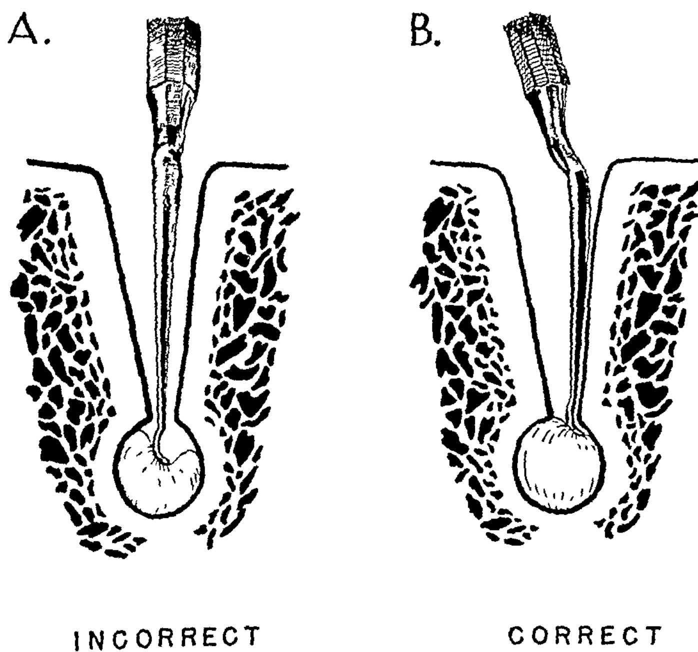


FIG. 48. *A*, incorrect and *B*, correct method of peeling out granuloma with double ended curet

TECHNIC FOR SUTURING ORAL MUCOSA

1. *Simple, Interrupted Suturing.* The student should master this method before becoming concerned about running or continuous suturing. Use of the interrupted stitch is always good surgery; use of the continuous suture leads to a gaping wound if there is any later cutting through at one or more points.

(*a*) The retractor is held in the *operator's* left hand so that he may adapt his exposure to the area he wishes to see and work upon.

(*b*) The tissue is immobilized and the needle thrust through at right angles to the surface, $\frac{1}{4}$ inch from the edge of the incised wound. The motion then becomes curved, since the needle is curved. The stitch should be so arranged that it crosses at right angles to the line of closure. When first learning to suture it is best to always go through each side of the wound with a separate bite of tissue. When more experience has been gained, opportunities will be found to pass through both sides with one stroke.

(*c*) After the first thrust of the needle the shaft should emerge to such an extent that the beaks of the needle holder can grasp it *back* of the point. The delicate tip of the needle is easily broken or bent by rough handling. The needle is drawn smartly through the tissue with a curved motion.

(*d*) The needle is then carried to the thumb and forefinger of the left hand while the latter retains its hold on the retractor. It is regrasped just ahead of the eye and the holder locked again.

(*e*) With the second side of the wound immobilized the needle again pierces the tissue so as to emerge at right angles to its surface and $\frac{1}{4}$ inch from the wound margin. Again the needle holder is unlocked, the needle grasped back of the point, and drawn through the tissue in a curved manner.

(*f*) At this point the *assistant* automatically takes the retractor and holds the lip or cheek well back.

Tying the Knot. (*g*) The needle is grasped between the thumb and forefinger of the left hand and pulled until only 1 inch of the suture remains.

(*h*) The needle holder is placed *on top* of the long strand of suture and pointed *up, toward the left shoulder*.

(*i*) The needle holder is wrapped around the strand of suture *two complete turns*. (This is in a clockwise direction—to the right.)

(*j*) The needle holder is rested on the left middle or index finger as this finger lightly strokes the coils of suture toward the ring handles, away from the box lock.

(*k*) While the finger rest is maintained, the open jaws of the needle holder are carried to the very tip of the short 1 inch end. The *very end* of the suture is grasped and the needle holder locked so that it clicks. (Failure to grasp the very end will result in a bow knot.)

(*l*) The coiled suture is drawn entirely off from the needle holder by pulling on the long end. The short end must be kept 1 inch long.

tied, leaving a 1-inch short end. With the fingernails the loop is stroked to the rear of the needle, so there will be no catch as it passes through tissue.

2. Sterile threaded needles may be stored with the desired length wrapped around a short piece of cotton roll into which the needle is thrust. Or they may be arranged in a folded sterile towel out at full length. As a standard item on the flap tray, the threaded needle is locked in the jaws of the needle holder, ready for use.

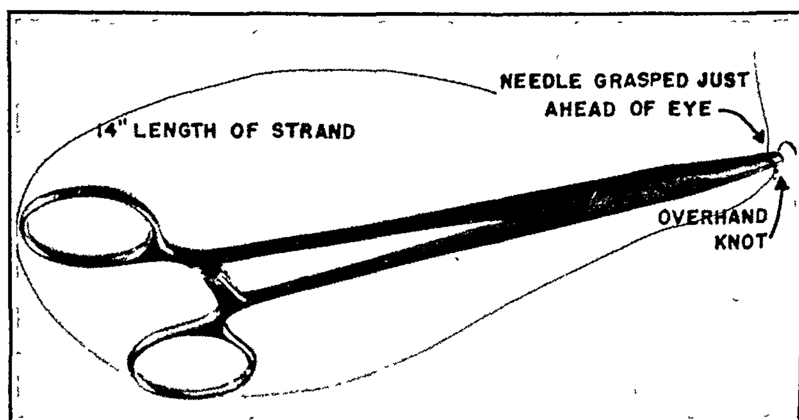


FIG. 49. Needle, suture, and needle holder.

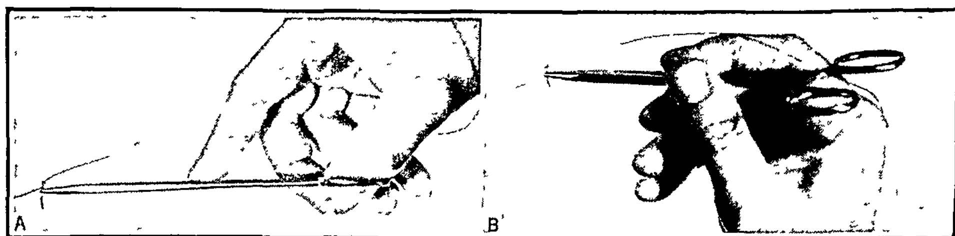


FIG 50. *A*, proper, and *B*, improper grasp of needle holder.

3. The needle is always grasped *just ahead of* the eye, to give maximum length of needle for passing through tissue. Needles are readily broken when grasped *on* the eye.

4. The needle holder is always grasped the same way, with just the tip of the thumb through one ring, one phalanx of the fourth finger through the other ring, and the index finger braced against the shaft, half way down. The other fingers close on the instrument in a natural position, thus giving a secure grasp, but one which permits instant dropping of the instrument when all fingers are straightened. (The same grasp is used for hemostatic forceps.)

5. The fountain pen grasp of the needle holder should be avoided whenever possible, as it requires two additional hand movements for release of the lock.

During this step the short end is directed *toward the throat* and the long end drawn forward, *out of the mouth.* The half-tied knot is drawn to the desired tightness. From here to the final tie both operator and assistant refrain from tugging on the suture or touching the knot with aspirator tip or retractor, so that it will not become loosened.

(*m*) The knot is now half done. For the second half, with the needle still between the left thumb and forefinger, the needle holder is placed *beneath* the long strand of suture material and again directed *upward.*

(*n*) This time it is wrapped around *one time* only. (This is in a counterclockwise direction—to the left.)

(*o*) Again the needle holder is rested on the left middle or index finger as this finger lightly strokes the coils of suture toward the ring handle, away from the box lock.

(*p*) Again, while the finger rest is maintained, the open jaws of the needle holder are carried to the *very tip* of the short 1 inch end. The very tip is grasped and the needle holder again locked so that it clicks.

(*q*) Again, the coiled suture is drawn entirely off from the needle holder by pulling on the long end. Again, the short end is directed *toward the throat* and the long end forward, *out of the mouth.* The knot should be set well by making two or three sharp tugs on both strands, pulling away from the knot.

(*r*) The needle holder is left locked to the short end.

(*s*) Everything (needle holder and long strand) is gathered into the palm of the left hand, with equal tension exerted on both strands of suture.

(*t*) With the scissors the suture is cut $\frac{1}{4}$ inch from the knot.

(*u*) The remaining short end is removed from the jaws of the needle holder, and the needle is regrasped just ahead of the eye, in preparation for the next stitch.

2. *The Figure 8 Stitch to Control Bleeding* (*Stitch Tie*). (*a*) Direct clamping of a bleeding vessel with a hemostat is to be preferred, but if this cannot be done, due to inadequate facilities in an emergency, this method is acceptable and effective.

(*b*) The probable location of the bleeding vessel is estimated and the needle passed deeply through both edges of the wound, slightly *ahead* of the bleeder.

(*c*) Another generous "bite" is taken through both sides of the wound, slightly *behind* the bleeder.

(*d*) The suture is pulled up snugly and tied with a surgeon's knot, somewhat tighter than for an ordinary interrupted stitch.

3. *The Mattress Stitch.* (*a*) This method is used to produce slight eversion of wound edges or to provide more absolute apposition of two raw surfaces, as in closure of an antra-oral fistula.

(*b*) The wound margins are considered as *near* and *far* edges.

(*c*) The needle is passed through the margins in the following sequence: *near*, *far*, *far*, *near*.

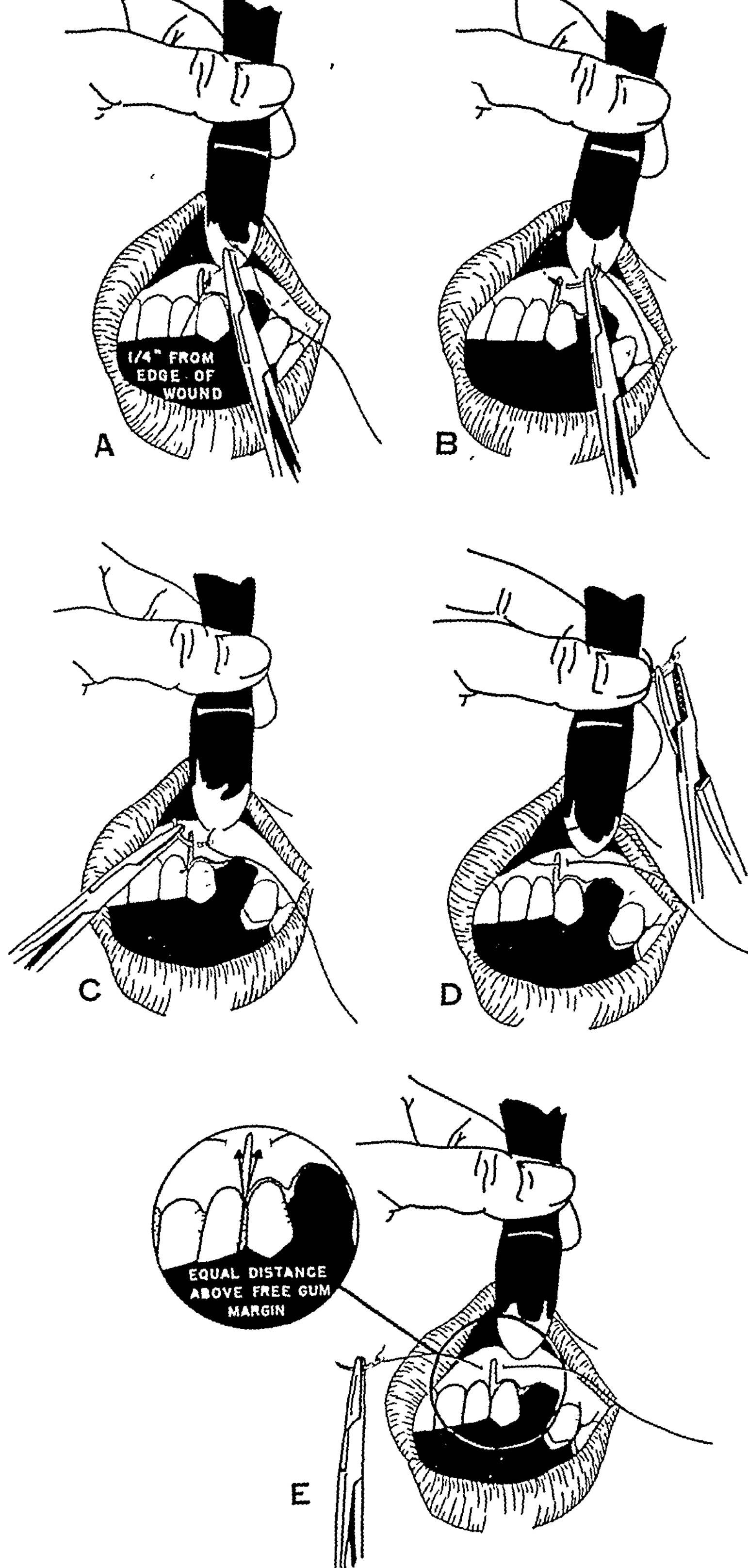


FIG. 51. Details of correct method of manipulating needle in suturing oral mucosa. *A*, Needle about to pierce tissue $\frac{1}{4}$ inch from edge of wound; *B*, needle pushed through tissue in curving manner; *C*, needle being drawn through—grasped on shank, not point, *D*, needle being regrasped just ahead of eye, while held by left thumb and forefinger; *E*, passage of needle through both sides of wound has been completed.



FIG. 52 —(*Continued*)

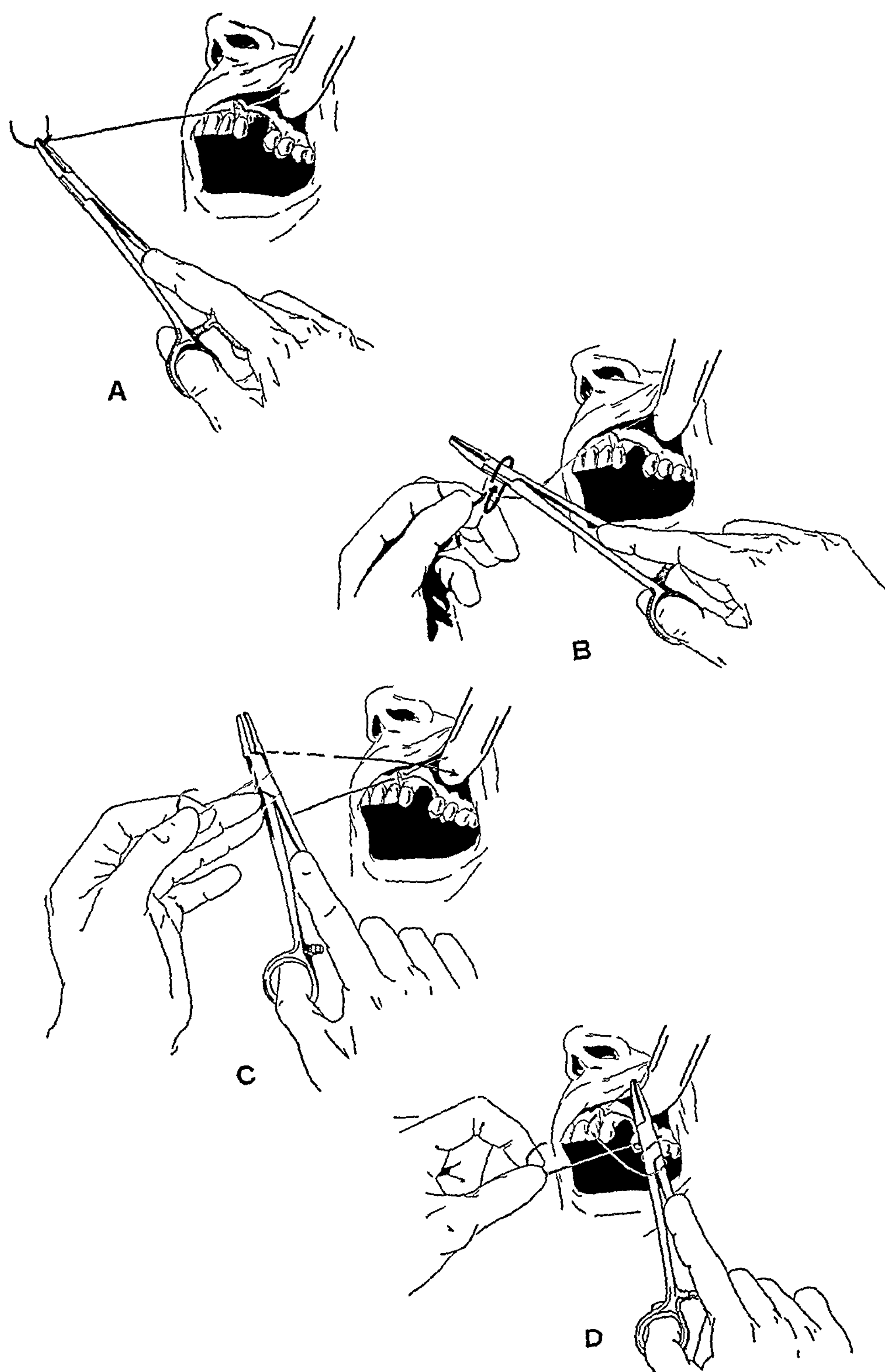


FIG. 52. The instrument method of tying the surgeon's knot. (See text for description.)

USE OF ABSORBABLE SUTURE MATERIAL

1. *For Tying Bleeders.* (*a*) Reference should be made to the section describing the *hemostat*.

(*b*) The catgut is held in the two hands and passed completely around the clamped vessel.

(*c*) The first half of the surgeon's knot is tied and tension maintained while the hemostat is carefully opened and removed by the assistant. This step seats the knot on the stalk of the vessel where it has been crushed.



FIG. 55. Traction suture.

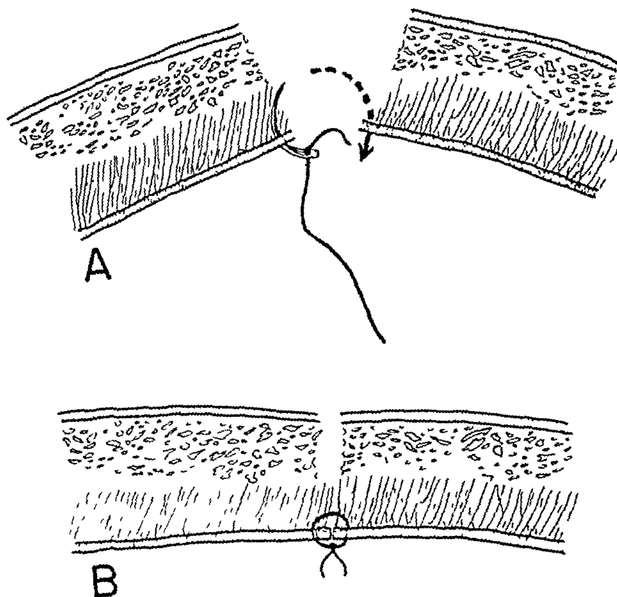


FIG. 56. Method of suturing fascia so that knot will be concealed in depth of wound.

(*d*) The suture is tied with a surgeon's knot.

4. *The Traction Suture.* (*a*) Occasionally, when the steel retractor cannot be conveniently used, this atraumatic, nonslipping method of securing retraction can be used to good effect.

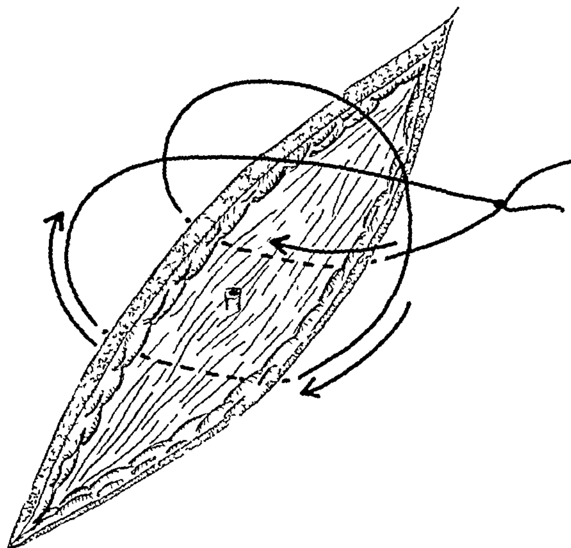


Fig 53. The figure 8 stitch tie

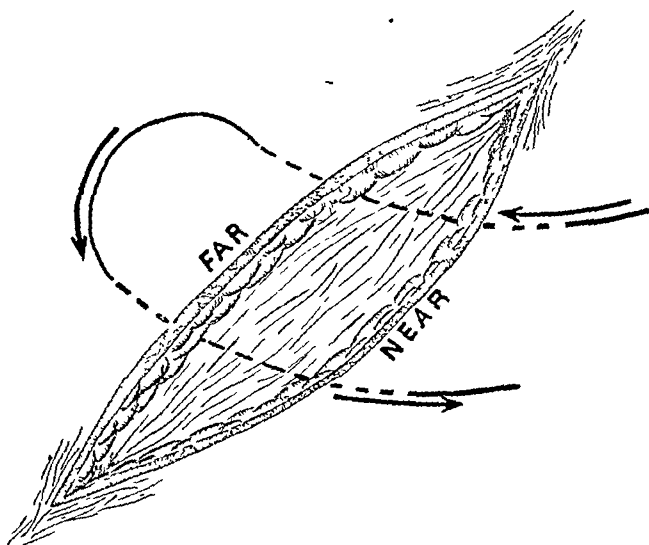


Fig 54. The mattress stitch

(*b*) The cutting edge needle is passed through the flap margin, ¼ inch from the edge.

(*c*) The double strand of suture material is grasped with a hemostat, about 1 inch from the tissue. Excess suture material is cut off, leaving the hemostat attached.

(*e*) The tissue margin is immobilized with the traction hook or tissue forceps. The scissors may be used in the manner described above for blunt dissection, but the operator will find that eventually he will have to sever the restraining bands of tissue by boldly cutting them with the scissors to achieve the desired relaxation.



FIG 57 Use of traction hook and scissors to undermine mucosa. (Clark, courtesy of J. Oral Surg)

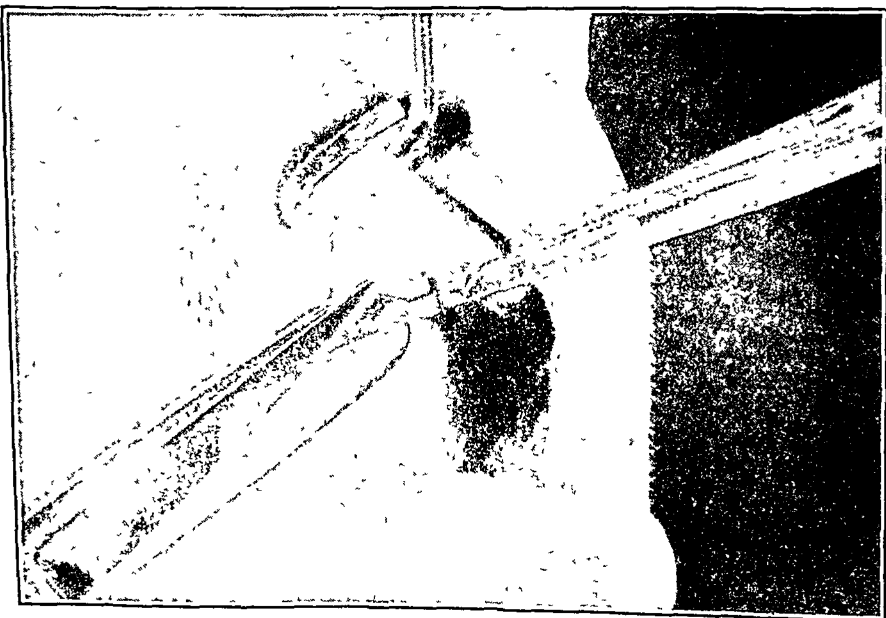


FIG 58. Correct method of removing intraoral sutures Three hands are needed.

(*d*) With care not to jerk the strands and thus loosen the knot, the second half is tied tightly and the ends cut approximately $\frac{1}{8}$ inch long. (See use of the scissors.)

(*e*) The instrument tie may be used, but well-soaked catgut will often cut through when grasped with the needle holder or hemostat.

(*f*) If the bleeding vessel is difficult to clamp and tie, the figure 8 stitch tie, using a round (noncutting) needle, may be employed.

2. *For Closing Muscle or Fascia.* (*a*) The catgut is threaded on a round (noncutting) needle, leaving one long and one somewhat shorter strand. Due to the greater friability of catgut it is usually not practicable to secure it to the needle with an overhand knot.

(*b*) The fascial or muscle margin is immobilized with a traction hook or tissue forceps. Ample bites of tissue, at least $\frac{1}{4}$ inch from the wound margin, are taken. The catgut is tied by hand, with the surgeon's knot.

(*c*) If the initial passage of the needle is made from beneath upward, and the second passage from superficial to deep surface of the tissue, the resulting knot will come to rest in the depth of the wound, so that there will be no projecting ends of suture material.

THE SCISSORS

Specifications

In the interests of simplicity of armamentarium it is best to select a single type of instrument for all purposes. The straight Stille or Mayo 6 inch instrument with two slender blunt tips will serve well for dissection as well as for cutting sutures or trimming wound margins. It is false economy to purchase cheap, poorly tempered scissors, and unwise to select the frail instruments designed for eye work, as they will not stand up when used on the tough oral tissues.

Method of Use

1. *For Trimming Wound Margins.* (*a*) The tissue is immobilized by use of the traction hook or tissue forceps, or by resting the scissors against the tissue, with the redundant portion extruding through the open blades.

(*b*) The cut should be made at right angles to the tissue surface.

2. *For Blunt Dissection or Undermining.* (*a*) The wound margin is immobilized with the traction hook or tissue forceps.

(*b*) The blades of the scissors are thrust into the tissue closed, and forcibly spread apart. The intent is to open up the tissues with minimal risk of severing nerves or blood vessels.

(*c*) The above method may also be used to enter a deep abscess, though the hemostat is generally employed for that purpose.

(*d*) An important use of the scissors is that of *undermining wound margins to prepare them for advancement* to a new location, there to be sutured with less tension than would be the case if they had not been freed up.

only a moderate roughness on the inner surfaces of their beaks to prevent slipping. The familiar foil carrier or cotton pliers is classified with the sponge forceps, even though the beaks are smooth.

Examples of the general group of sponge forceps which are commonly used in oral surgery are. the foil carrier, the common hospital straight 4½-inch sponge forceps, and the nasal dressing forceps. The latter has a bayonet handle and long slender beaks well-suited for carrying gauze into the depth of a cavity such as the antrum or a large cyst.

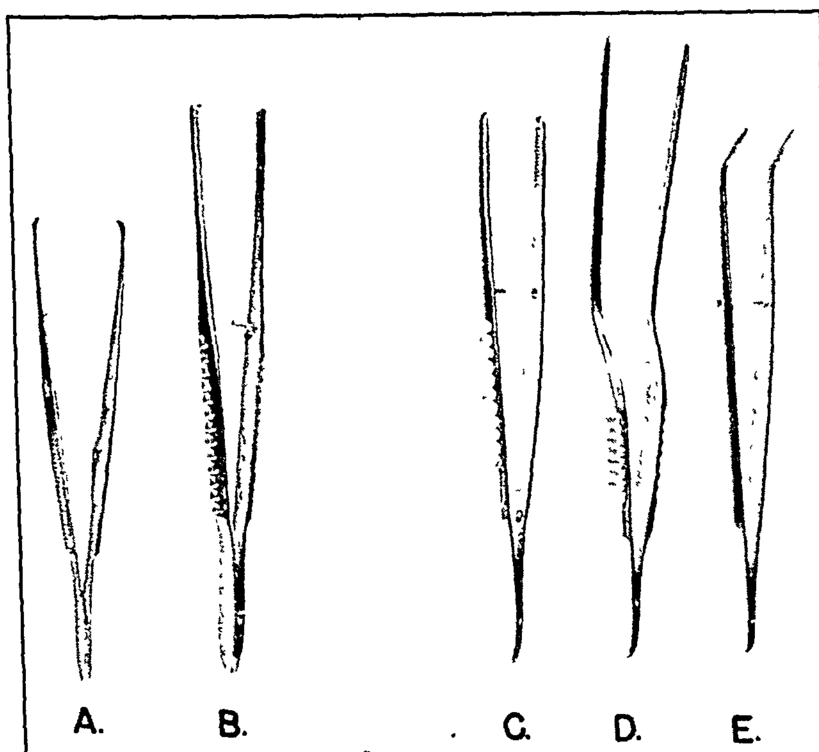


Fig 59 Tissue and sponge forceps *A*, O'Brian tissue fixation forceps, *B*, hospital type tissue forceps, *C*, hospital type sponge forceps; *D*, nasal dressing forceps, *E*, foil carrier

Examples of the general group of tissue forceps are the common hospital straight 4½-inch tissue forceps with sharp teeth, and the O'Brian fixation forceps with somewhat flatter teeth. The latter will serve better if the catch lock is removed.

Suggestions for Use

Sponge forceps should never be used to grasp tissues as they slip unless excessive, crushing pressure is applied. Tissues should never be handled with anything except sharp traction hooks, sharp toothed forceps, or properly designed retractors. In working upon the skin of the face, where minimal edema, fibrosis, and scarring are imperative, plastic surgeons now use traction hooks for virtually all immobilization or manipulation purposes.

(*f*) The bed thus created will present bleeding vessels which must be dealt with by direct clamping or firm, sustained pressure. However, adequate undermining is the prerequisite for success in any plastic procedure in the mouth which contemplates moving tissue to a new location.

3. *For Cutting Sutures.* (*a*) As the strands of suture material are held on a slight stretch, one blade of the opened scissors is rested against them and made to slide down to within $\frac{1}{4}$ inch of the knot ($\frac{1}{8}$ inch for buried sutures).

(*b*) The blades are closed together smartly. An effort should be made to achieve a rhythm or tempo for this oft-repeated act.

(*c*) In all technics described in this book, the operator always cuts his own intra-oral sutures, using the right hand, and the scissors are returned to the same location at the right rear of the tray after each use. This prevents operator and assistant from always being uncertain who is going to cut the knots. This is one of many decisions made in advance for all cases. The operator is selected for this function because the assistant is retracting with one hand and aspirating with the other. Further, there are many inaccessible spots in the mouth where the operator alone has clear vision. Since he must cut the sutures in such instances, it is best that he do so always.

4. *For Removing Sutures.* (*a*) This action requires three hands.

(*b*) The assistant retracts the lip or cheek with a retractor, mouth mirror, or tongue blade.

(*c*) The operator holds in his left hand the foil carrier, sponge forceps, or tissue forceps.

(*d*) He holds the scissors in his right hand.

(*e*) The operator secures a hand rest for the grasping instrument, then lightly picks up the free end of the suture, placing it on a slight tension. With the scissors lightly rested on lip or cheek he snips *one* of the taut strands.

(*f*) The stitch is drawn from the tissue and placed on the neck towel.

(*g*) When this method is used sutures can be removed quickly, painlessly, without producing bleeding, and without inadvertently cutting both strands.

(*h*) While it may sound like a violation of aseptic principles, neither operator nor assistant need scrub for this brief procedure, providing neither touches the patient's tissues either directly or indirectly, and neither handles the sterile working ends of the instruments.

THE TISSUE AND SPONGE FORCEPS

Specifications

The prime difference between the two types of instruments is that those used for grasping tissue have sharp teeth, while those employed in manipulating gauze, cotton, or suture material have

which appears to contain the bleeding vessel. Some degree of skill is required to unerringly clamp the bleeder without including an excessive amount of extraneous tissue.

(*c*) Careful reflection on the anatomy of the region and the probable origin of the vessel will help the surgeon to know where to clamp proximal to the bleeding point.

(*d*) The bleeding vessel is often more superficial than would be expected. The actual white-walled vessel can frequently be seen.

(*e*) A vessel only partially severed, and thus unable to retract, constitutes one of the most dangerous types of bleeders.

(*f*) For the method of *tying* bleeders, see the section on the use of absorbable suture material, p. 95.

2. *For Blunt Dissection.* (*a*) For the second step in incision and drainage, the closed beaks of the hemostat may be used forcibly to enter the abscess without undue hazard of injuring vessels and nerves. When the deepest point is reached the beaks are forcibly spread apart to permit the pus to escape and enlarge the passage for future drainage.

(*b*) For undermining a flap preparatory to advancement the instrument is used in the same manner, but the scissors will often serve to better advantage.

3. *For Removal of Tooth Fragments or Root Tips.* Due to its slender beaks and the firm control provided by the long handles, a hemostat will often succeed in lifting out a stubborn, movable fragment due to the traction and rotation effect provided by a grasping instrument.

4. *For Grasping and Holding Tissue Such as Cyst Membranes.* Where an indefinite plane of cleavage exists, separation can often be accomplished by steady traction in one or more directions after the tissue has been firmly grasped with the hemostat. However, the portion which is crushed becomes unsuitable for pathological study.

5. *For Grasping Traction Sutures*

(See section on the use of Nonabsorbable Suture Material, p. 94.)

THE DENTAL MIRROR

Specifications

The boilable, plane dental mirror is used.

Indications for Use

1. For preoperative examination, either as a mirror or as a retractor. (See suggestions for use of retractor in examination and postoperative treatment, p. 72.) The glass face of the mirror is held against the cheek to permit inspection of buccal and labial aspects of ridges by direct vision.

2. For cheek retraction in postoperative treatment, such as changing of gauze dressings or suture removal.

The foil carrier is well suited for postoperative dressings in oral surgery. It may be used to carry a cotton pledget into a tooth socket or bony cavity to dry it prior to placement of a dressing, or to carry the dressing to place.

For suture removal the O'Brian fixation forceps, straight sponge forceps, or nasal dressing forceps are somewhat better than the foil carrier as their broad beaks make it easier to grasp the small thread on the first attempt.

THE HEMOSTAT

SPECIFICATIONS

While a wide variety of clamping forceps may be found in the hospital operating room, only the mosquito and Kelly type are generally used for intra-oral work. These are available in both straight and curved design. Variations such as the Kocher, Allis, and Carmault will be occasionally needed in the more major procedures in the hospital. Their application will be mentioned in the discussion of those procedures.

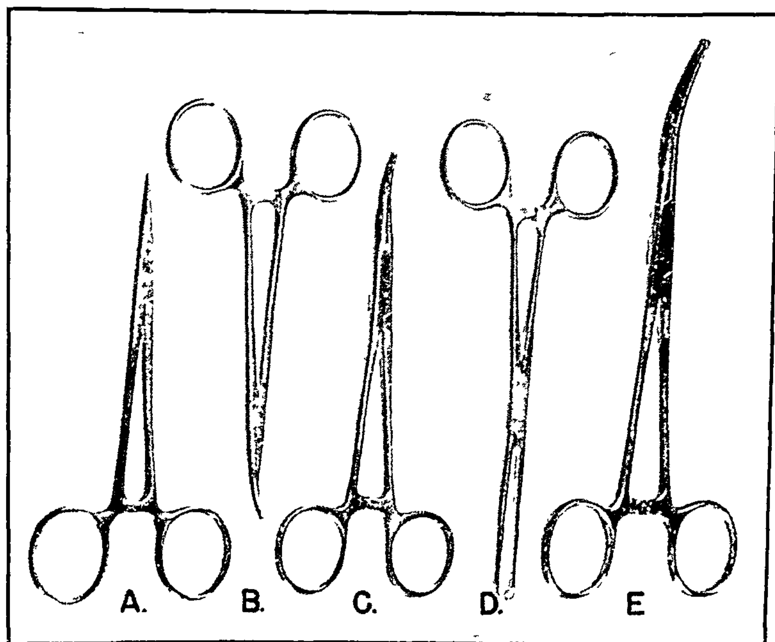


FIG 60. Various types of hemostats *A*, Straight mosquito, *B*, curved mosquito; *C*, curved Kelly, *D*, Allis, *E*, Carmault

MODE OF USE

1. *For Clamping Bleeders.* (*a*) The bleeding site should be well exposed by good retraction and illumination.

(*b*) The area is compressed with a gauze sponge and as the latter is quickly removed the beaks of the hemostat grasp the bit of tissue

the aspirator tip should be applied nearby, as close to the field as possible but at the lowest point. Care should be taken not to flood the patient's throat with irrigating fluid.

5. Whenever the operator reaches for the dental handpiece the assistant automatically reaches for the chip blower syringe to provide the action described above, without verbal request of the operator.

6. The assistant must be prepared instantly to give up the aspirator to the operator without verbal request, and instantly to accept it from him in the same way, for the operator occasionally has to

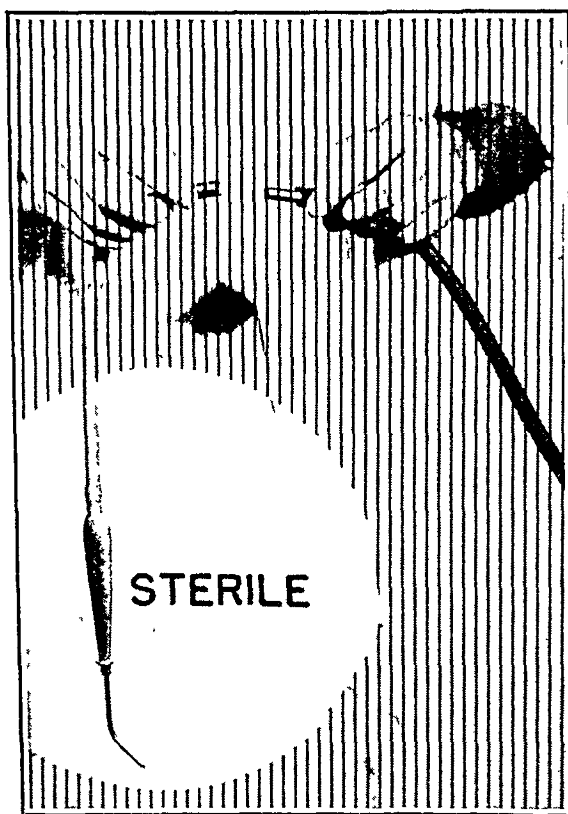


FIG 61 Maintaining sterility of suction aspirator handle and tip while connecting them to source of suction

police a small recess that is not visible to the assistant. The operator may thus keep his vision uninterruptedly on the operative field throughout this exchange.

7. Whenever the assistant's trained ear detects that the aspirator is partially plugged, she must immediately free the obstruction. This is done by thrusting into the orifice the iron wire pick or one beak of the foil carrier. A finger rest should be secured to make this action successful on the first try, so that the aspirator will not be out of function for more than two or three seconds.

8. Effective use of the aspirator will make it unnecessary for the patient to use the cuspidor at any time during the operation, and

3. *Rarely*, for examining the depth of a socket during tooth removal procedures. Every effort is made to work by direct vision, which is usually possible with the aid of the headlight.

4. Occasionally for retraction of the tongue, when the retractor is already in use, during surgical procedures.

THE SUCTION ASPIRATOR HANDLE AND TIP

Specifications

The Hu-Friedy Coupland item is used. Four tips of various sizes are supplied, of which the three smallest will be most useful. Two small holes should be drilled just back of the orifice of the tip. A 12- or 14-inch length of heavy rubber tubing should be prepared which is boiled and attached to the back of the handle before use. This permits a nonsterile assistant to make connection with the nonsterile source of suction without contaminating the metal handle. An iron wire pick may be made in the dental laboratory to be used as a ramrod to dislodge particles of bone which may become caught inside the lumen during use. A large ramrod of coathanger wire is needed to thoroughly clean the inside of the handle prior to sterilization, while cotton applicators work well to scrub the interior of the connecting section of rubber tubing. The suction aspirator handle, tip, and tubing must be thoroughly flushed and mechanically cleansed after each using and prior to boiling.

Use of the Aspirator

1. The aspirator is held in the assistant's right hand in the fountain pen grasp. The long, nonsterile rubber tubing passing to the source of suction is laid on the right shoulder or may pass diagonally over the assistant's wrist to prevent kinking. A 3 × 3-inch gauze square is always held in the assistant's left hand to receive bone chips and other débris picked up by the suction tip.

2. The assistant must be trained to methodically keep four areas free of blood, saliva, and débris. They are: (*a*) The floor of the mouth, (*b*) the right and left retromolar triangles, (*c*) the junction of the tongue with the soft palate, and (*d*) the operative field.

3. In policing the operative field the assistant must strive to provide excellent visibility for the operator. This requires a certain amount of judgment for if the aspirator is providing a dry field but is blocking the view of the operator, no useful purpose will be served. The effect to the surgeon is like that of sitting behind a post in a theater. The aspirator tip and all instruments should be slanted away from the center of the field like petals of a flower, so that the headlight beam and line of vision may be directed at the center of interest. When not needed the aspirator should be held 6 to 12 inches from the field, to give the operator all possible room.

4. When it is indicated, the assistant should lightly flood the operative field with intermittent streams of water or saline delivered from the chip blower syringe, held in the left hand. Simultaneously

the aspirator tip should be applied nearby, as close to the field as possible but at the lowest point. Care should be taken not to flood the patient's throat with irrigating fluid.

5. Whenever the operator reaches for the dental handpiece the assistant automatically reaches for the chip blower syringe to provide the action described above, without verbal request of the operator.

6. The assistant must be prepared instantly to give up the aspirator to the operator without verbal request, and instantly to accept it from him in the same way, for the operator occasionally has to

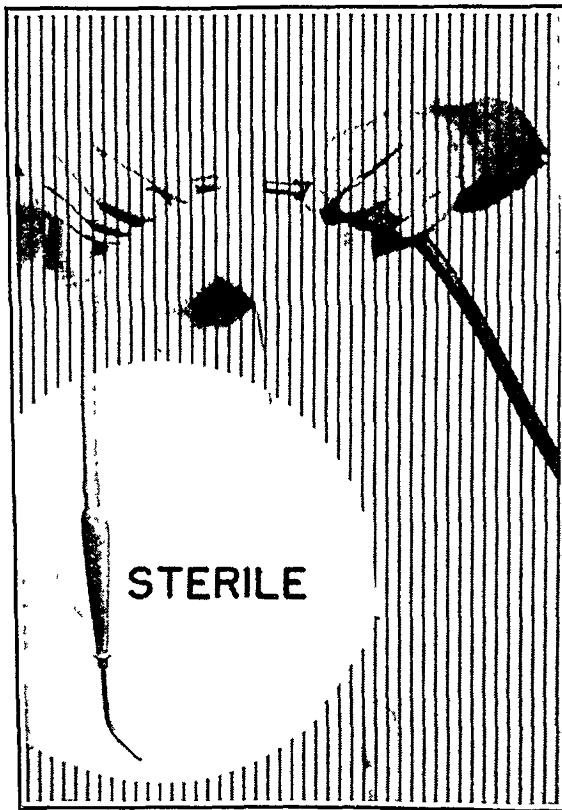


FIG 61. Maintaining sterility of suction aspirator handle and tip while connecting them to source of suction

police a small recess that is not visible to the assistant. The operator may thus keep his vision uninterruptedly on the operative field throughout this exchange.

7. Whenever the assistant's trained ear detects that the aspirator is partially plugged, she must immediately free the obstruction. This is done by thrusting into the orifice the iron wire pick or one beak of the foil carrier. A finger rest should be secured to make this action successful on the first try, so that the aspirator will not be out of function for more than two or three seconds.

8. Effective use of the aspirator will make it unnecessary for the patient to use the cuspidor at any time during the operation, and

this should be explained to the patient as surgery begins. If the patient makes an effort to reach the basin the assistant should gently push the head back into the headrest, then immediately remove the previously overlooked fluid or débris.

THE CHIP BLOWER SYRINGE

SPECIFICATIONS

The common rubber bulb syringe, with tip at 45 degrees from the shaft, is used. The advantages of this item are low cost, simplicity, and ease of sterilization by boiling. It is used in conjunction with a large enamel or stainless steel cup filled with warm tap water or normal saline.

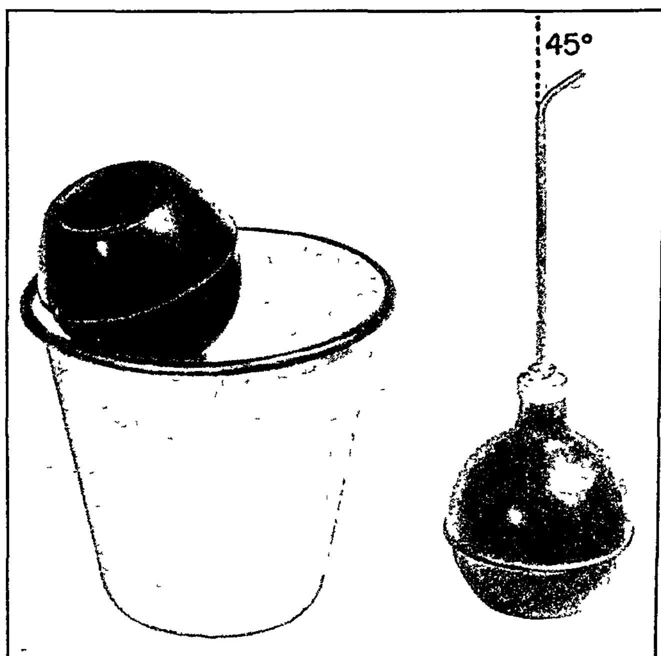


FIG 62 Chip blower syringes and enamel cup for irrigating solution.

SUGGESTIONS FOR USE

1. Since the suction aspirator is customarily held in the assistant's right hand, the chip blower syringe is held in the left when only brief usage is required. For prolonged use such as flushing the surgical bur in tooth sectioning or major bone removal, it is usually more convenient to hold the aspirator in the left hand and the syringe in the right. The 3 × 3-inch gauze square is always kept in the palm of the left hand.

2. When it is known that considerable use will be made of the surgical bur, two syringes should be provided in the enamel cup so that one will always be full and ready for instant use.

3. When a syringe is nearly empty it is pointed upward and the bulp compressed to expel all air, then inserted into the enamel cup full of water, with the tip down.

4. Small intermittent streams of water over the revolving bur or operative field will provide adequate irrigation and better visibility than large quantities applied infrequently. (See use of the suction aspirator, p. 102.)

5. In order to avoid blocking the view of the operator, the assistant will usually find it best to squirt the irrigating fiuid parallel to and very close to the blade of the retractor.

6. Care should be taken to avoid flooding the throat as this will lead the patient to interrupt the operation so that he can reach the cuspidor.

THE TOOTH EXTRACTION FORCEPS

Specifications

All upper forceps are designed with beaks in line or approximately in line with the long axis of the handles.

All lower forceps have beaks at a 45- to 90-degree angle with the long axis of the handles.

The following is a suggested list of forceps:

1. For upper anterior teeth:
   Clev-Dent 99c, or
   Clev-Dent 1
2. For upper bicuspid teeth:
   Ash 32a, or
   S. S. White 32, or
   Clev-Dent 150
3. For upper first and second molars:
   Clev-Dent 8s and 9s, and
   Ash 52
4. For upper third molars:
   S. S. White 210, or
   Clev-Dent 210
5. For single rooted lower teeth
   Ash 22, or
   Clev-Dent 6 or 12
   S. S. White 151
6. For lower first and second molars
   Clev-Dent 16 or 23, or
   S. S. White 16 } cowhorn type

   Clev-Dent 15, or
   S. S. White 15, and
   Ash 33 } grasping type
7. For lower third molars
   S. S. White 222, or
   Clev-Dent 222

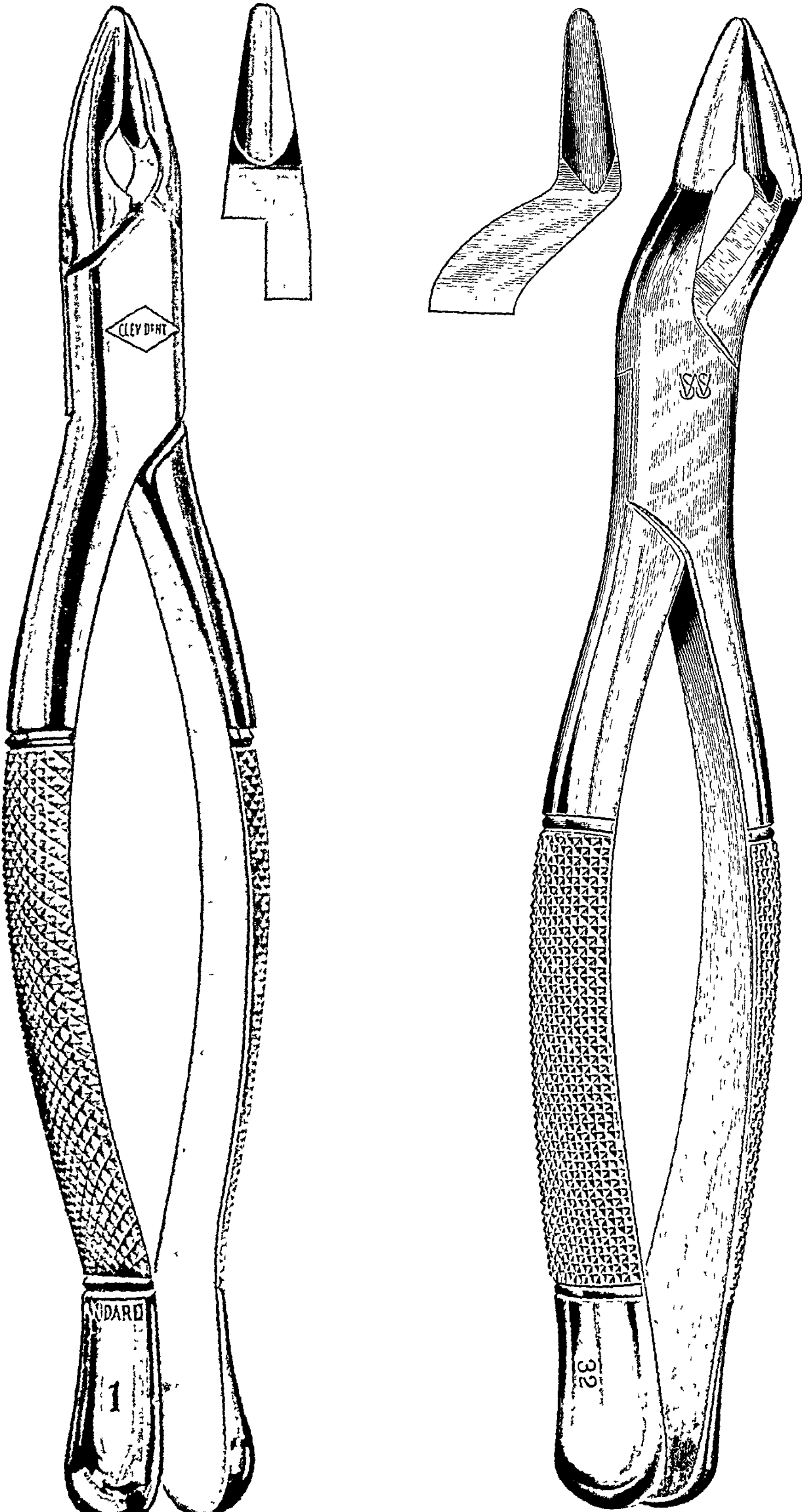


Fig. 63

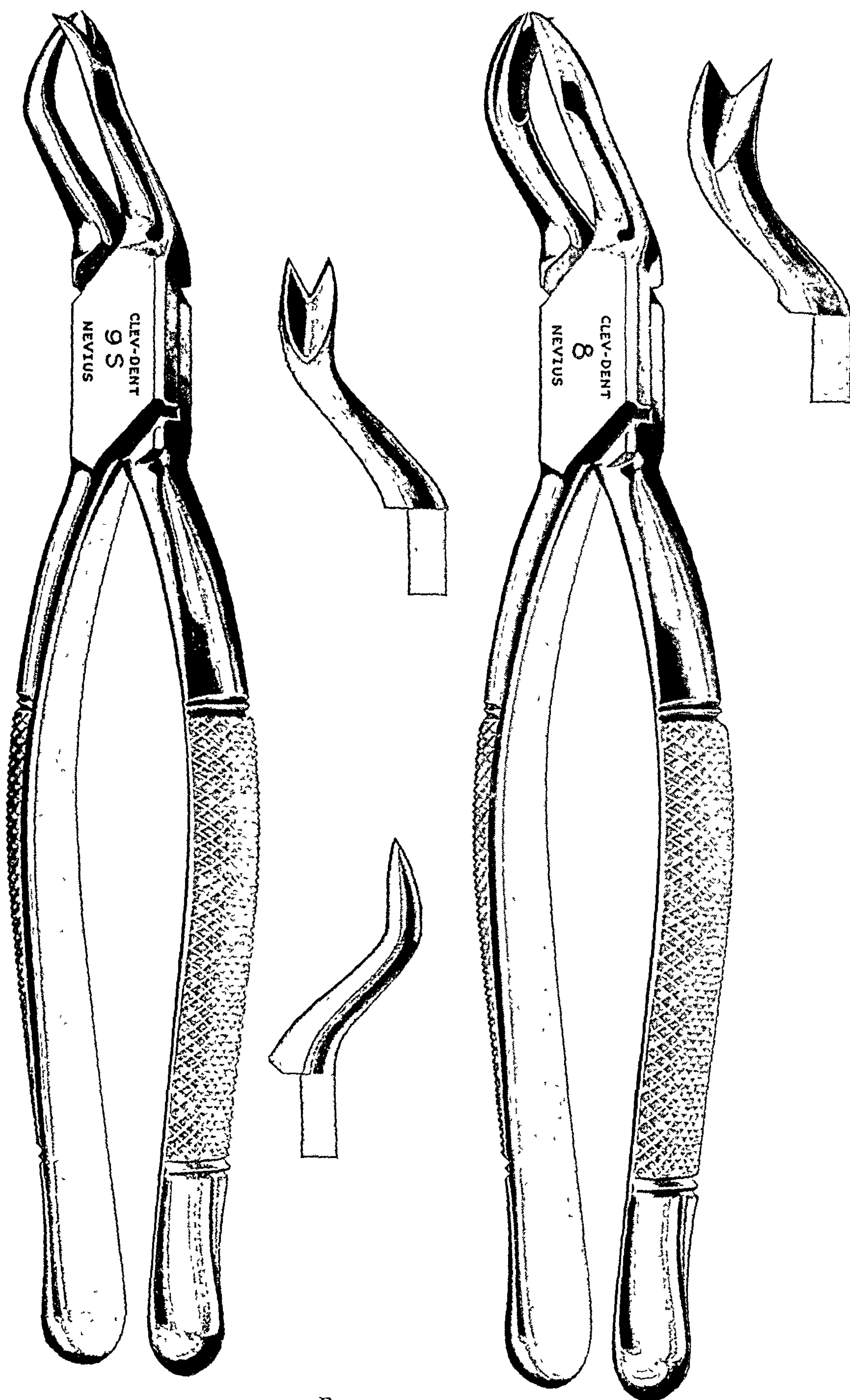


FIG 63.—(*Continued*).

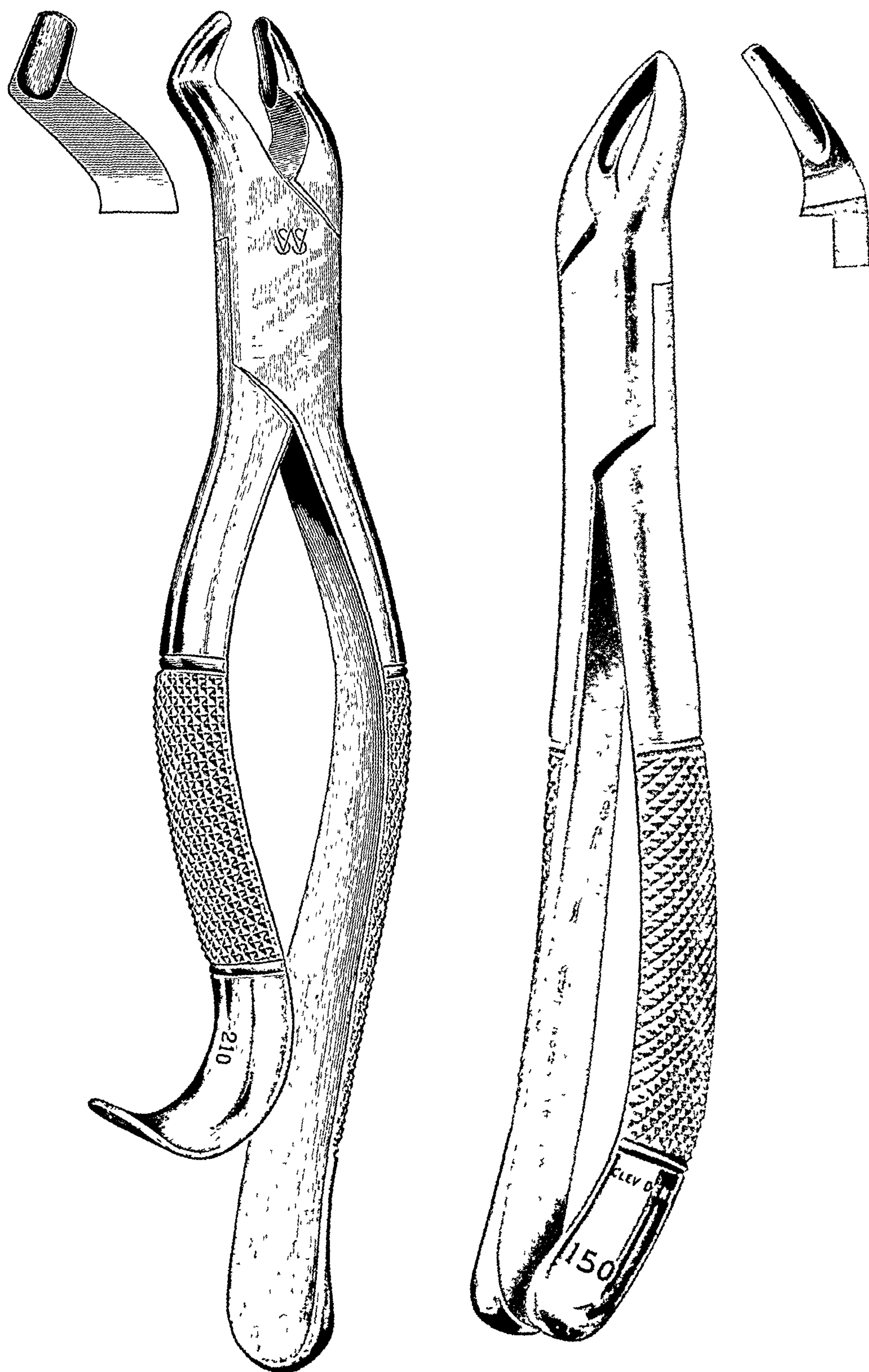


Fig 63 —(*Continued*) Various types of upper extraction forceps (Cleveland Dental Mfg Co and S. S White Dental Mfg. Co)

NOTE: Literally hundreds of types of extraction forceps are available on the market, and most of them are useful instruments. The prospective purchaser should visit the various dental supply houses to learn which items are currently procurable. Usually it will be found that similar designs may be obtained from several different dealers, but with different numbers on the instruments. Therefore it is evident that the brands and numbers given in this list are suggestions only.

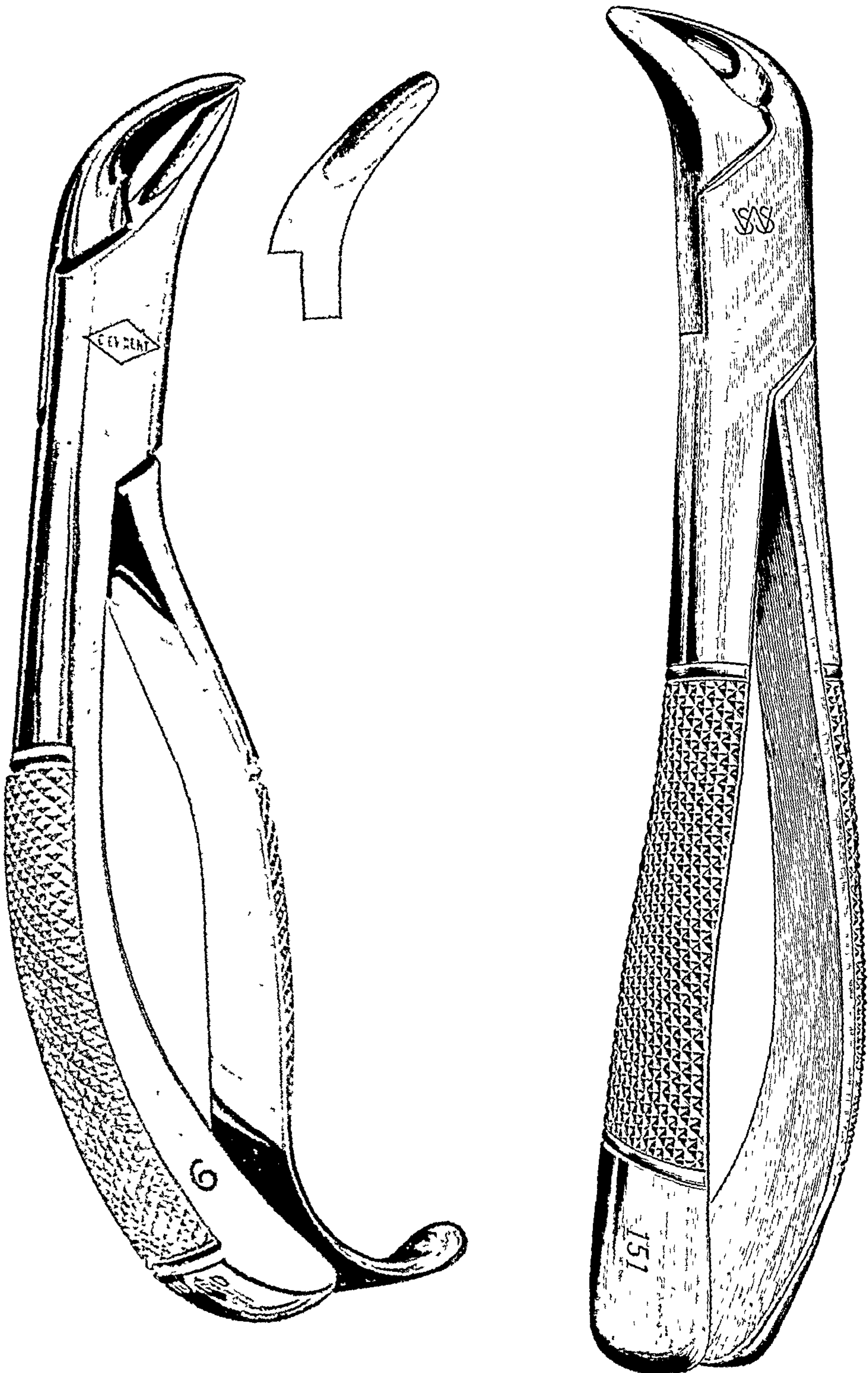


FIG. 64 Various types of lower extraction forceps (Cleveland Dental Mfg Co and S. S White Dental Mfg. Co)

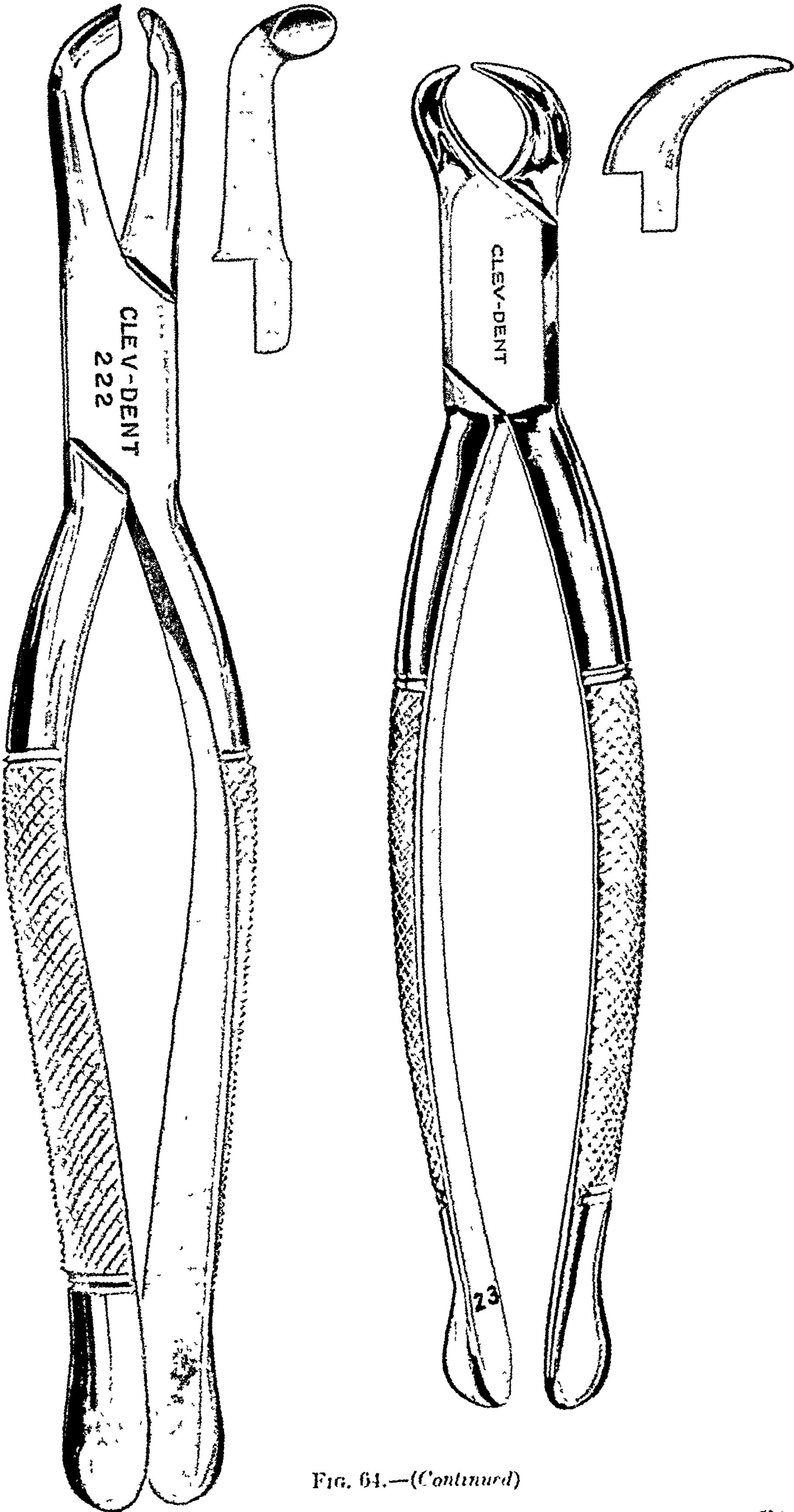


Fig. 64.—(*Continued*)

Instructions for the use of extraction forceps will be found in the section on basic oral surgical technics, p. 148.

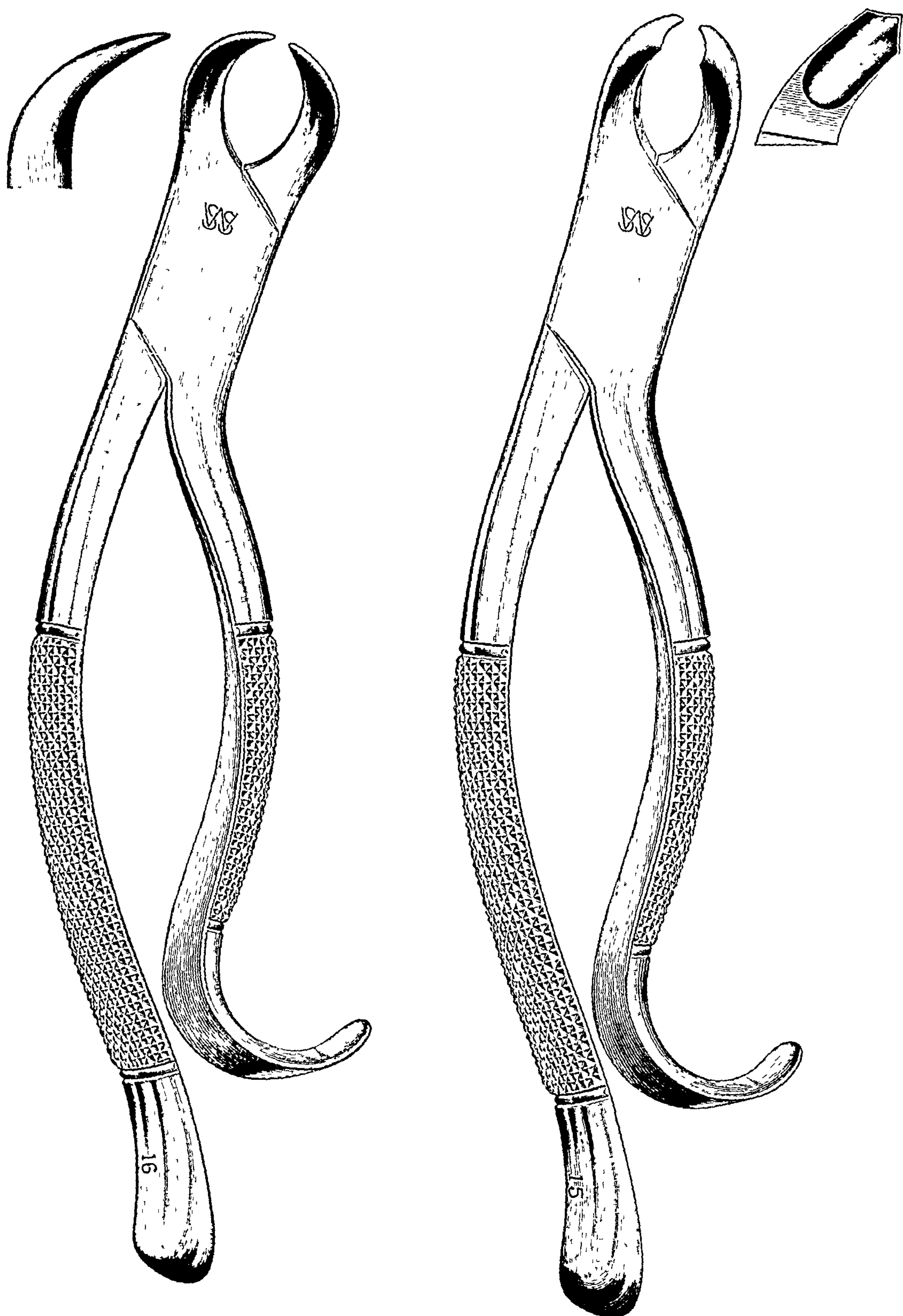


Fig. 64— (*Continued*).

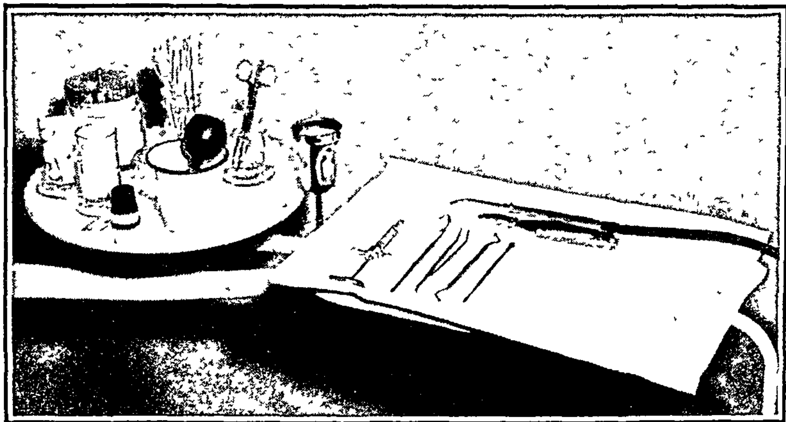


FIG. 65 Setup for simple extraction.

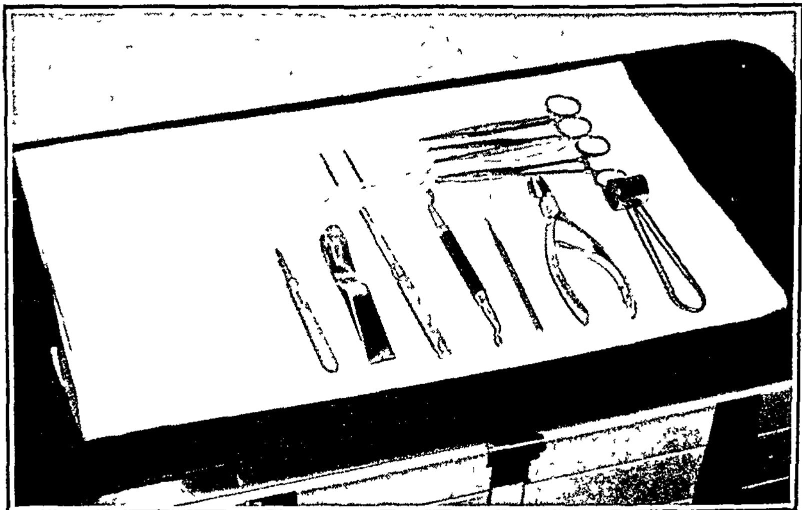


FIG. 66. The flap tray.

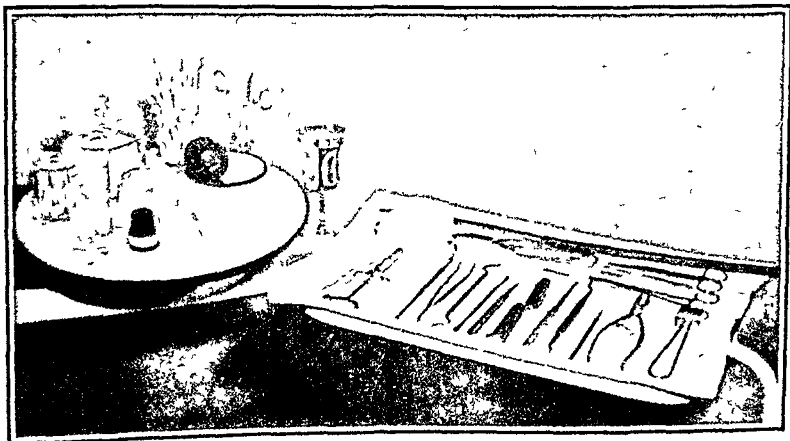


FIG 67. The two combined.

SETUP FOR SIMPLE EXTRACTIONS

Figure 65 illustrates the setup for the simple extraction of one or two teeth, where no root fracture is anticipated and no bone trimming is contemplated. This setup is shown arranged on a Mayo table, while the receptacles for sterile supplies are arranged on the bracket table of the dental unit. An alternate plan is to arrange the simple extraction setup on the bracket table and have the various jars and bottles on a nearby cabinet or table.

THE FLAP TRAY

In the chapter on The Seven Minimum Essentials (p. 133) the items comprising the flap tray are listed, and their arrangement described.

CONSOLIDATING FLAP TRAY AND SIMPLE EXTRACTION SETUP

When it is necessary to bring the flap tray into play during the course of an operation, the tray is held near the instrument table by a nonsterile member of the team. The items of the simple extraction setup are then transferred in a sterile manner to the flap tray (see Fig. 67.) Elevators which may be required for the completion of the procedure are added to the tray at this time by means of the sterile pickup forceps.

When it is known that the flap tray will be required at the outset, this transfer is done prior to the start of the operation.

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5

Sterilization, Asepsis, and Supplies

SINCE the publication in 1867 of Joseph Lister's paper on antiseptic surgery the elimination of pathogenic bacteria from surgical wounds to prevent infection has become universal practice. There has been considerable change from the original concept, however. Although Lister made the attempt with his "carbolic spray," it is manifestly impossible to eliminate all bacteria from the operating room, and from the operator's and patient's body surfaces. It is necessary to distinguish between bacteriological as against surgical sterility.

Most pathogenic bacteria are incapable of surviving long outside of the animal body. To put it another way, the greatest danger lies in direct transference of warm, moist, bacteria-laden material from one patient directly to another.

It must be frankly recognized, when all practical considerations are taken into account, that sterilization and asepsis are relative matters. They have both quantitative and qualitative considerations. That is to say, measures should be used which have a high chance of killing large numbers of organisms, but at the same time certain measures must be used to attack specific pathogenic organisms.

In both ways, quantitatively and qualitatively, every effort should be made to keep the level of asepsis high. It must be admitted that in all offices, clinics, and hospitals, it constantly tends to sag because of the labor and expense of maintaining good discipline. The occurrence of an occasional severe postoperative wound infection or needle abscess will serve to force immediately the degree of asepsis up again.

It is almost universal practice to include at least one graduate nurse among the personnel of every oral surgery office or clinic, as it has been found they contribute much to the maintenance of a high level of aseptic technic, due to the rigid "sterilization conscience" inculcated in their training.

PURPOSES OF STERILIZATION AND ASEPSIS

PROTECTION OF THE PATIENT

The patient seeking oral surgical care in this day and age has every right to assume that all possible steps will be taken to prevent wound infection. While esthetic considerations are not truly a part

of asepsis, patients are prone to judge the level of aseptic technic used in an office by the general appearance of orderliness, cleanliness, state of repair of the office and equipment, and the grooming of the dentist and his assistants. Although enamel and chrome are pleasing to the eye, and modern, well-designed fixtures are to be desired, the presence of attractive equipment is no assurance of good aseptic technic. Pathogenic bacteria from previous patients may be smeared all over the handles, switches, and valves of beautiful equipment. The dentist's conscience must lead him to do his work in such a manner that these organisms do not find their way into the patient's tissues.

Measures taken to protect the patient must be meaningful, necessary, and effective. At the same time, the labor, cost, and time required to provide each feature of aseptic routine must be weighed against the need.

Protection of the Operator and Sterile Assistant

Any routine to be used in the dental office must offer a good margin of safety to the operator and others who may come in contact with the patient or contaminated instruments. Protection must be afforded against respiratory infections, accidental puncturing of the fingers, and injury to the eyes from flying bone chips or tooth fragments.

APPLICATION OF ASEPTIC PRINCIPLES

Asepsis in the Hospital Operating Room

Since aseptic technic is found in its purest form in the hospital operating room, the dentist must be familiar with the details thereof. He will then be in a better position to understand the modifications which may be made in adapting this technic to the environment of the dental office.

The level of operating room asepsis is kept high by the ceaseless efforts of the graduate nurse who is the supervisor. It is her duty to see that physicians, dentists, nurses, maids, and orderlies all obey the rules for maintenance of asepsis.

Basically all operations are classified as either "clean" or "dirty." The latter are further subdivided into those which are simply performed upon a contaminated region such as the mouth or rectum, and those upon patients who have infectious diseases such as scarlet fever, tuberculosis, or diphtheria. For each classification there is a particular routine for preparation of the operative field, manner of draping, and disposition of the instruments and linen after use. The discovery of diphtheria in a patient who has just been operated upon may call for complete sterilization of the entire operating room—walls, floor, tables, light fixtures, etc.

Extra-oral Procedures. Complete aseptic technic for "clean" cases is directed toward preventing any live bacteria of any type from entering the surgical wound. By definition this limits clean

operations to those which can be performed through the intact skin.

1. *Preparation of the Operator and Sterile Assistants.* This begins with a change to clean but not sterile scrub clothing and the donning of cap and mask. The ritual of "scrubbing" is then performed, to sterilize hands and forearms. The scrub routine traditionally carried out for clean cases is conducted as follows: The sleeves are arranged so that the elbows are exposed. Rings and wrist watches are removed and the hands briefly washed with soap and water. A sterile brush is then picked up carefully so as not to contaminate other brushes in the container, and the hands, forearms, and elbows



FIG 68. Scrubbing up



FIG 69 Sterile nurse helping operator into sterile gown

generously lathered by the use of brush, soap, and water. All of these surfaces are methodically scrubbed for a period of five minutes by the clock. The first brush is then discarded and the nails are cleaned under running water with an orangewood stick or nail file. A second sterile brush is then used again to scrub hands and forearms, with particular attention to the tips and sides of the fingers. When a total of ten minutes has been devoted to the task, the brush is dropped and all lather rinsed off under a stream of water, with the hands held uppermost and great care exercised to prevent any part of the scrubbed area from touching any nonsterile surface.

The hands are held up to permit drainage of water from the elbows. Next the hands and forearms are bathed in 70 per cent alcohol or 1:1000 Zephiran with a scooping motion which ends by holding the hands aloft and allowing the excess fluid to drain back into the basin.

If, instead of ordinary soap, pHisoderm containing hexachlorophene is used, the time for scrubbing may be reduced from ten minutes to five.

With the hands still held up, and with studious care to prevent contamination of his hands and forearms, the scrubbed individual then approaches the sterile nurse who hands him a sterile towel. At this point a seeming incongruity must be explained. In spite of the elaborate preparation of hands and forearms, these uncovered



FIG. 70. Sterile nurse helping operator to draw on sterile gloves.

members are now considered nonsterile! The nurse must therefore take care not to become contaminated by them. The hands are carefully dried on the towel but it must be made certain that no part of the towel touches the more sterile hands which has touched the less sterile elbows. The towel is dropped and the hands thrust into the sterile operating gown which the sterile nurse now holds extended with sleeves opened. When a nonsterile assistant has drawn the sleeves into place by grasping inside them and tied the gown securely at the rear, the hands are thrust into sterile rubber gloves which are held open by the sterile nurse. In this operation care must be taken that no part of the bare hand touches any part of the *exterior* of the glove. When the gloves have been carefully drawn over the wristlets of the gown, the individual is now considered to be sterile. From this point on he must allow no contaminated object to touch his hands, arms, or front of the chest, for

such a "break in technic" would require immediate changing to new sterile coverings.

2. *Preparation of the Patient.* The skin of the patient is prepared for operation by shaving, scrubbing with germicidal soap, then painting with other solutions such as ether, 70 per cent alcohol, or 1:1000 Zephiran. Aqueous Zephiran solution is generally applied around the upper face and the tincture used where there is no hazard of getting it in the eyes. It is doubtful whether the skin remains sterile for more than a matter of minutes, even after this painstaking preparation, as bacteria are present in the hair follicles and sweat glands, and these emerge to contaminate again the skin surface. These measures, performed to sterilize the skin, are referred to as preparing or "prepping" the field. "Draping" means the isolation of the sterilized area with autoclaved towels and sheets so that the operating team can work in sterile attire without risk of contamination from the operating table or nonsterile parts of the patient's body.

3. *Preparation of the Instruments and Supplies.* In the true aseptic technic all instruments are boiled or autoclaved. All linen, rubber gloves and operating gowns are autoclaved under steam pressure.

4. *Aseptic Technic During the Operation.* During the operation objects and surfaces are rigidly classified as either sterile or contaminated. If any individual in the room observes contact of a sterile with a nonsterile object he immediately announces that a "break in technic" has occurred, and steps are taken to correct the damage. If a portion of the drapes has become contaminated, new sterile linen may be laid over the area. If an instrument becomes contaminated it is dropped into a sponge basin or passed to a nonsterile attendant, to be resterilized. Hand contamination calls for a change to a new sterile glove. Occasionally an entire instrument table must be taken down and completely reset, because of contamination.

Registered nurses and physicians are rigidly trained in this routine for clean surgery, and it becomes second nature to them. When the dentist works in the operating room he must conform in every detail, for any deviation from the accepted routine stands out as unconventional procedure. Dental interns and oral surgeons quickly learn the etiquette of aseptic surgery and find it is better policy to conform rather than to challenge the logic of time honored procedure.

Intra-oral Procedures. For operations within the mouth which are to be performed in the hospital operating room, it is customary to carry out essentially the same routine as that used for clean cases, even though there is little consistency to such a course. It is felt by most authorities that sterilization of the oral cavity is not practicable. The supposition is that aseptic precautions by the operator and nurses will protect the patient from outside contamination, and that his own organisms will seldom cause wound infection

since he is probably immune to them. These tenets are difficult to substantiate by scientific proof, but there is considerable clinical evidence indicating that patients cared for in the hospital operating room heal with less evidence of infection than those cared for in an office or clinic. Many factors are involved besides wound contamination, however, such as bed rest, good nursing care, more use of antibiotics, and so on.

On the whole, it is better judgment to follow the essentials of aseptic routine for intra-oral work in the operating room, than to attempt to delete certain elements on the impulse of the moment. The face is shaved, scrubbed with soap and water, and prepared with aqueous Zephiran solution, more as a gesture rather than with any conviction that it will result in a truly aseptic operation. In a sense this might be considered an act of courtesy to the nurses who have labored so hard to prepare sterile instruments and supplies for the operation! On the other hand, nurses generally accept philosophically the impracticability of attempting to sterilize the oral cavity itself. It is possible that in the near future the use of potent antibiotic troches or solutions may become standard procedure, for this purpose, but at the present time the use of these agents to prepare the mouth for oral surgery is not commonly practiced.

When a dentist finds that he is working in a particular hospital quite frequently, or intends to do so, it is a good plan to discuss the matter of aseptic technic as it applies to intra-oral work in some detail with the operating room supervisor. He may find that she is receptive to some special plan which will curtail the cost and labor of preparation of drapes, gloves, and other measures, so that the environment will more closely resemble that of the dentist's office. The dentist will have to use his judgment as to whether this overture is in order and will be taken in the proper spirit.

Asepsis in the Dental Office or Clinic

There is no denying that it would be ideal to perform every tooth extraction or other intra-oral operation with complete aseptic technic. sterile gown and gloves, cap, mask, and full sterile drapes for the patient. At the same time it must be recognized that these measures are costly and time consuming. It is doubtful whether the average patient, who would ultimately have to pay for such services, would be willing to do so. Much oral surgery is performed upon people in the low income group. They are able to pay for the essentials, but the additional expense for supplies and labor occasioned by the use of the total sterile environment is difficult to justify. There must be consistency to the logic for the use of any routine measure used to enhance aseptic technic. The procedure used must be one which can be practiced year in and year out, and which produces the desired result of preventing wound infection.

In the office or clinic the dentist must make his own decisions regarding sterilization and aseptic routines, but coupled with this obligation is the privilege of selecting those methods which he sin-

cerely believes are important and necessary. For convenience, the measures to be employed can be divided into preoperative, operative, and postoperative.

Preoperative Preparations. These include those relating to the operator and sterile assistant, those which concern the patient, and those directed at sterilization of instruments and supplies.

1. *Preparation of the Operator and Sterile Assistant.* These individuals are customarily garbed in white apparel which is easily laundered and esthetically acceptable. While it is not essential that the operator wear a new gown for each patient, it is unthinkable that anyone would approach a patient with the intent of operating while exhibiting blood stains from the preceding case. It must be conceded that this consideration is largely one of appearance, but many patients are exceedingly sensitive to the sight of blood. If it is impossible for the dentist or assistant to change from soiled garments before proceeding with the next case, a clean towel may be clamped or pinned over the stained area to eliminate the distress to the patient which would otherwise result from this cause.

An operating room type cap may be worn by both operator and assistant, for reasons of appearance, to prevent hairs from contaminating the instruments, and to reduce the chance that hair, particularly that of the assistant, might become caught in the belt of the dental engine.

Masks are seldom worn for office oral surgery unless either member of the team is obliged to operate while suffering from an acute upper respiratory infection. (See Tuberculosis, p. 64.)

The use of rubber gloves is not advised. Not only do they introduce a considerable loss of tactile sense, but their use adds expense as well as the nuisance of upkeep. Furthermore, proper scrubbing with soap and water renders the hands sufficiently sterile for work in the oral cavity. The following daily routine for the care of the hands of the surgeon and sterile assistant fulfills the practical requirements of simplicity and greatest protection for both patient and operator.

(*a*) At the beginning of each period of work in the office, rings and watches are removed, the sleeves are rolled up to the elbows, and the hands and forearms are scrubbed with soap and warm water for five minutes. Soap containing hexachlorophene is desirable. During this scrub the fingers are given special attention and the nails, which have been trimmed to a length of 1 or 2 millimeters, are cleaned with brush and file. At the end of five minutes the hands are dried on a clean towel—laundered but not autoclaved. The hands are now considered to be sterile.

(*b*) At the conclusion of the case both operator and assistant wash or scrub the hands with warm soap and water for thirty to sixty seconds. If gross blood is present beneath the nails they are cleaned with the nail file and given additional attention with the brush. This postoperative scrub removes pathogenic bacteria from the

hands and thus protects the operator, at the same time preparing the hands for the next patient.

2. *Preparation of the Patient.* The patient is seated in the chair and prepared for operation by a nonsterile member of the operating team. Superfluous outer clothing is removed and tight collars or neckties are loosened. The backrest, headrest, and chair height and inclination are properly adjusted. A freshly laundered towel is pinned about the head to cover the hair and a large towel or rectangular drape is secured about the neck to cover the chest. Another towel may be laid in the patient's lap to be used by him for wiping the mouth during the course of the operation, if necessary. If this is not provided the patient will tend to use his own handkerchief for the purpose. Cosmetics should be removed with a gauze square and the face may be swabbed with a sponge moistened with 1:1000 Zephiran solution.

3. *Preparation of the Instruments and Supplies.* Sterilization of the instruments will have been performed in advance.

Everything possible should be boiled for twenty minutes or autoclaved under steam pressure for a similar period. It is imperative that local anesthetic syringes and needles be boiled or autoclaved. Sharp instruments such as scalpels, scissors, chisels, and sharp-pointed elevators may be sterilized by soaking for at least thirty minutes in 1:1000 Zephiran solution or some other effective agent, in the interests of retaining the sharp cutting edge. However, if they have previously been used on a case of acute pyogenic infection they should be boiled or autoclaved. Gauze squares, applicators, and any other materials composed of cotton fibers must be autoclaved and their sterility maintained through the period of storage and through the process of transfer to the sterile table.

Aseptic Operating Technic. All aseptic precautions which have been taken prior to the operation will become meaningless unless a rigid but practical discipline is maintained throughout the entire surgical procedure. It is humanly impossible for the dentist and his sterile assistant to think out every act and motion with regard to whether it will violate the aseptic routine, while they are concentrating on the details of the operation. These principles must be learned by *training* so that they become well-established habits. The essential thing to keep in mind in maintaining the desired status of asepsis is that the hands must touch nothing which is contaminated. They may touch anything on the sterile table, the suction aspirator and *sterile end* of the connecting tubing, the patient's face, mouth, or tissues, or the nearby areas of linen which have been placed around the head and chest. They must *not* touch the cuspidor, adjustment handles on chair or dental unit, *x*-ray viewing box, *etc.* Should one of these "breaks in technic" occur, the contamination must be removed by again scrubbing the hands for thirty to sixty seconds. In this regard, a further advantage of the headlight may be mentioned. Adjustment during the operation is unnecessary unless the operator must change his position from front to rear of the patient. He may

accomplish the necessary change in direction of the beam by simply pushing upward or downward on the light with the upper part of the forearm. The hands and lower part of the forearm are considered highly sterile and must not be so contaminated.

At this point the reader will probably discern an apparent inconsistency in the logic of the routine which has been described. How can it be stated that aseptic technic is being employed when it is quite evident that the patient's oral organisms will soon be spread over the hands of the operator and sterile assistant, as well as all over the "sterile" table? The answer lies in one of the primary purposes of sterilization and asepsis—protection of the patient. For his protection it is essential that the chain of contamination be broken between him and all previous patients. All of these facilities are sterile *for this patient only*. While it is more or less a figure of speech to speak of the present patient's mouth as being sterile, it is an assumption that must be made to give logic to the concept. There are some instances where the mouth must be considered septic. Whenever a needle puncture is to be made for the injection of local anesthetic solution, the mucosa must be dried and painted with a germicidal solution before the puncture wound is made. The extreme hazard of planting anaerobic pathogens deep in the tissues makes this precaution necessary. Also, whenever local anesthesia is to be used around an acutely inflamed region, care must be taken not to inject *through* infected tissue *into* an uninvolved area.

Fortunately, several factors make it possible to operate in the oral cavity without the development of a high percentage of wound infections. The rich blood supply enjoyed by oral structures, the suction aspirator's constant removal of débris and bacteria from the operative wound, and the fact that oral surgical wounds are often left slightly open for drainage all contribute to favorable healing. There can be no denying that rigid aseptic routine for operations within the mouth would be desirable if it could be readily accomplished. The fact is that with the use of a routine such as that which has been described, the incidence of postoperative infections is so small that further reduction is difficult to accomplish even with superhuman efforts.

Asepsis in Postoperative Treatment. In general, the hazard of wound infection is not felt to be so great several days after surgery as at the time of operation. Somewhat less rigid attention may be paid to details of aseptic technic, although only boiled instruments must be used and reasonable cleanliness observed throughout.

To emphasize the need for *rational* application of aseptic principles in the dental office, a method will be described for suture removal or extremely simple dressing changes, which is acceptable on the grounds that it gives the patient full protection against infection from the operator or his instruments. It is called the "no touch" technic The boiled instruments are laid on a clean towel. The operator's and assistant's hands *need not be freshly washed*, for they carefully touch only the ends of the handles. During the brief

treatment only the instruments touch the patient's tissues, and at no time are the fingers placed in the mouth. Neither must the fingers come in contact with the ends of the instruments which are to touch the patient. The assistant retracts the cheek with the mirror while the dentist picks up each suture with the dressing forceps and snips it with the scissors. This extreme example of the application of common sense to aseptic practice is given simply to emphasize the need for keeping in mind the *purposes* of aseptic routine. The saving by such a short cut is purely in *time*, but there are occasions where the compromise can justifiably be made.

The most extreme example of such license the author has seen was during a rotating medical internship. During the period of duty on the eye service, a number of "needling" operations for cataract were being done. One elderly ophthalmologist made it a practice to come to the operating room literally with dirt beneath the finger nails. His hand preparation consisted of a thirty *second* wash—no scrubbing—and no gloves were worn. The operation required only two instruments, a conjunctival fixation forceps and a cataract knife. The surgeon emphasized, for the benefit of the horrified nurses and interns, that he would at no time touch the patient nor the working end of the instruments. The operation consisted of about three motions, which accomplished the incision of the anterior capsule of the lens. All patients healed without infection!

While such practice can not be condoned, the story illustrates the distinction that can be made between the ritualistic as against the practical aspects of aseptic technic.

STERILIZING EQUIPMENT

Sterilizer. Boiling water is one of the cheapest and most effective media for the sterilization of surgical instruments. In an emergency a saucepan filled with water may be used. For general purposes, boiling should be continued for twenty minutes to provide a margin of safety. High altitude lowers the boiling point, so that a slightly longer time should be used. Spores are not killed by boiling but they are not generally considered to be a hazard in oral surgery. In the rare case in which the presence of spores is suspected, all material should be autoclaved at 250° for thirty minutes.

For ordinary use in the general dental office an electric sterilizer of sturdy construction and inside dimensions of 11 by 5 by 3 inches is very satisfactory. For surgical clinics or offices doing large numbers of complicated cases the 17 by 8 by 6 inch size is required.

All instruments should be thoroughly cleansed in running water with a conveniently shaped slender brush, prior to boiling. The interior of aspirator handles, tips, and connector tubings should be thoroughly cleaned with cotton swabs on applicator sticks and cleaners made of wire of suitable size. If blood is not removed before boiling it will congeal into an amorphous mass and produce stains which are difficult to clean off.

FIG. 71 Small electric sterilizer, suitable for dental office.

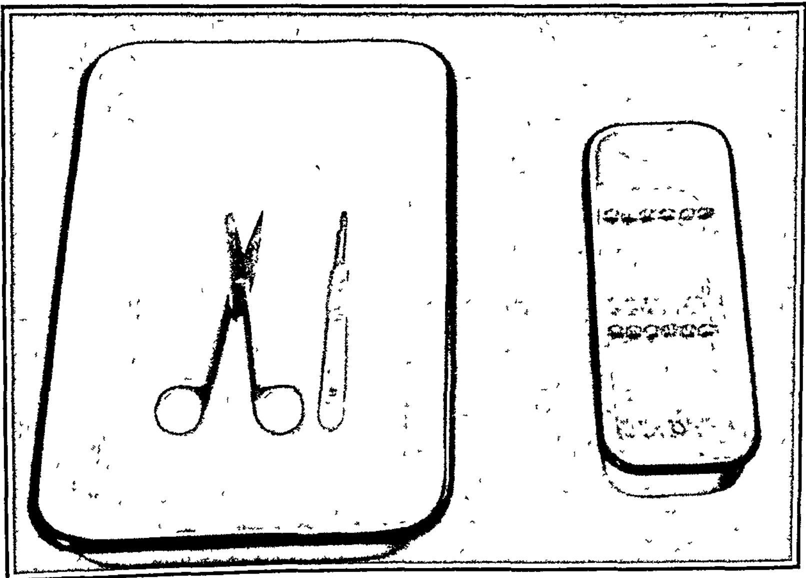


FIG 72 Zephiran pans for cold sterilization

When sterilization has begun, no further instruments must be added until the time is complete, as all water in the boiler would be assumed to have become contaminated.

Some prefer to use distilled water for the sterilizer but this introduces an additional expense. Tap water works very well, providing it is removed at the end of each day, and new water put in the next morning. In this way there is no formation of scale produced by the accumulation of lime salts.

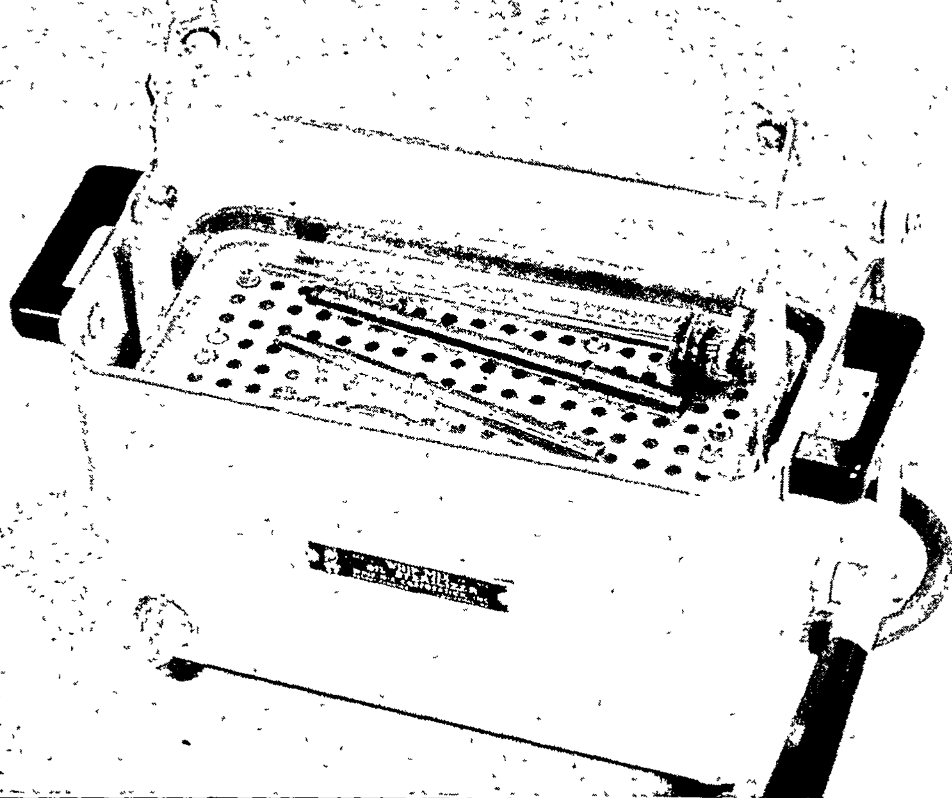


Fig 73 Hot oil sterilizer.

When sterilization is complete and the instruments have drained in the lifting tray, all except the local anesthetic syringes may be dried with a freshly laundered or autoclaved towel. The hands must of course be sterile for this work, just as when prepared for an operation. The drying may be omitted, but it tends to reduce the amount of rusting in the joints of chrome plated instruments, and improves the appearance of all, for water spots are eliminated.

Cold sterilization by 1.1000 Zephiran chloride solution is accomplished in flat enamel pans, which are available in various sizes. The 4 × 8 inch and 7 × 11 inch size work well for this purpose. One may be used for active sterilization and the other for storage

of items which are to be used directly from the solution. Only sharp cutting instruments, suture material, and local anesthetic carpules are sterilized in the cold solution. Thirty minutes in 1:1000 Zephiran chloride is considered to be sufficient. Drying with the towel is indicated to remove the slippery film which would otherwise remain.

A *hot oil sterilizer* with inside measurements of 8 × 4 × 4 inches is used for the sterilization of dental handpieces. Thirty minutes at the thermostat setting of 250 ° is considered adequate. Some dentists use this form of sterilization for all sharp cutting instruments.

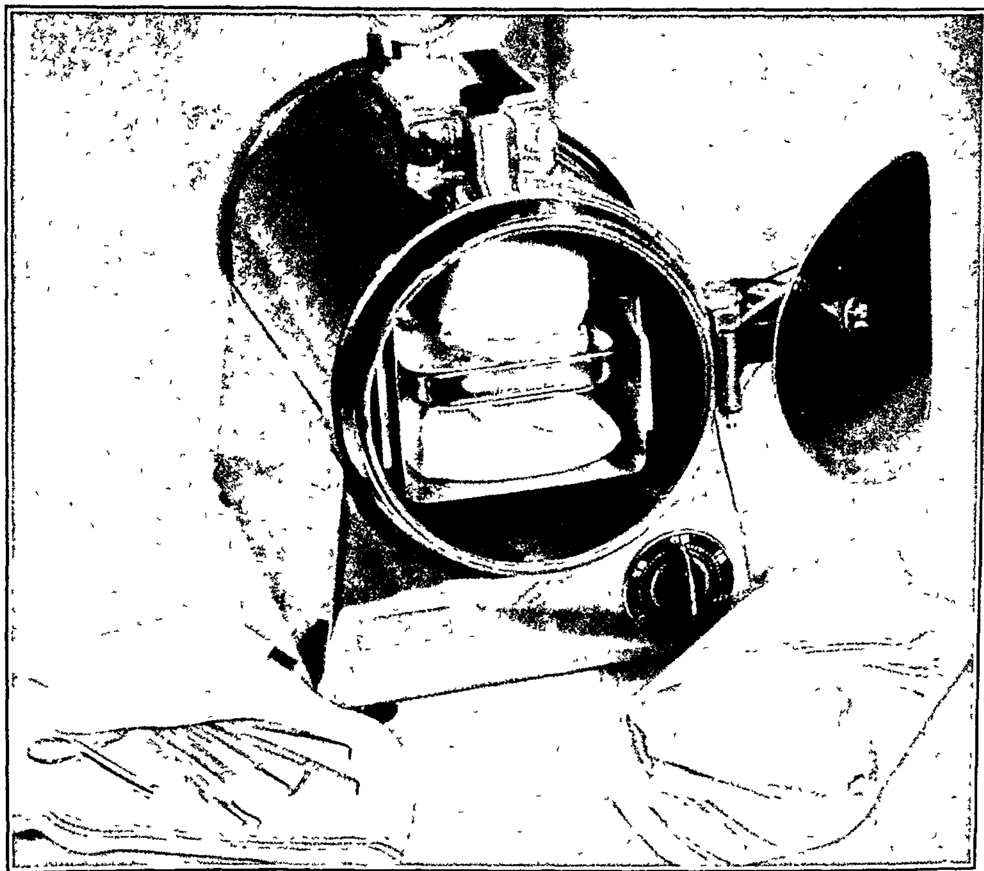


Fig 74 Autoclave

It is undoubtedly more efficient than the cold solution, but the removal of oil presents somewhat of a problem.

An *autoclave* is a desirable but not essential piece of sterilizing equipment for the dentist's office. If none is available, towels and drapes may be used just as they come from the laundry, or wrapped bundles of these items may be taken to a local hospital once a week for autoclaving. Gauze squares or sponges may be purchased already autoclaved, and stored carefully to preserve their sterility.

On the other hand, if the dentist does own an autoclave it may be used for many purposes usually accomplished by other means.

Gauze squares may be made up from material purchased in a large bolt and autoclaved right in the office, with some saving in cost. Sharp instruments, or even all instruments may be sterilized by the steam pressure method. It is all a matter of personal preference, depending on how much emphasis is given to cost, time, and method of carrying out aseptic principles. Twenty minutes at 250° gives proper sterilization. To secure this temperature the pressure must be carried up to 15 or 18 pounds per square inch.

STORAGE OF INSTRUMENTS

After sterilization and drying, instruments are laid in an orderly fashion on towels in drawers, on shelves of a cabinet, or on a large supply table. This transfer should be made with sterile hands or pickup forceps. Every office should have at least one pair of these forceps constantly available, which is kept with the tips immersed in 1 1000 Zephiran or other germicidal solution when not in use. The three-pronged type is very useful; a large Carmault forceps also serves well for some purposes. This instrument becomes the bridge between a nonsterile hand and a sterile instrument, carpule, or gauze square.

Local anesthetic syringes are given special consideration in storage to insure that no possible contamination of the needle can occur. A good method is to lay them between two layers of an autoclaved towel, with the transfer from the sterilizer being made with the sterile beaks of the pickup forceps. A syringe is carried from the storage area to the operating table by means of the same pickup forceps and the needle is arranged on top of a sterile gauze square, then 5 or 6 additional squares are piled on top of it. The needle is replaced to this location after each use during the operation, to protect it against chance contamination from fingers or blood-stained instruments.

Local anesthetic carpules may be kept in a flat enamel pan containing Zephiran and taken from this sterilizing bath with the pickup forceps as needed. To use them directly from their factory pack container, even if the end of the carpule is flamed, constitutes a rather indefensible break in technic, for the sterility of the hands is lost as soon as the unsterilized carpule is touched.

SUPPLIES

A certain amount of standardization is desirable in outfitting the dental office for oral surgical work. The more variations of types of items included in the inventory, the greater will be the cost and amount of time required to keep track of supplies and order replacements. The items listed and briefly described here should prove adequate for all ordinary purposes.

Gauze Squares. The 3 × 3 inch size serves well for many purposes. This is the item which is always held in the assistant's left

hand, to wipe the suction tip and receive all loose débris from the operative field. Should the aspirator become plugged or fail to function for some other reason, the gauze square may be used for hand sponging until the aspirator is working again. The gauze is used to dry and grasp the cheek or lip in making local anesthetic injections, and to grasp and tense these structures for excisional procedures. The use of the gauze squares to preserve the sterility of the injection needle has already been mentioned.

The 3 × 3 inch gauze squares may be purchased already made up, either sterile or nonsterile. They are stored in sterile glass or metal jars.

Cotton swabs on applicator sticks may be bought ready for use and the convenience is well worth the cost. If not previously sterilized they must be autoclaved prior to use. They are used for painting germicidal solution on the mucosa prior to injection. This item is not suitable for wiping saliva from the site of injection; this is better done with the gauze square.

Tongue Depressors. Many uses will be found for this familiar item of medical equipment. They may be stored in a sterile or just clean status, depending on the intended use. They have the advantage of low cost, and provide an acceptable means of retracting lips, cheek, or tongue for brief oral examinations where it is necessary to view but not palpate the intra-oral structures.

Cotton Balls. The size which is $\frac{5}{8}$ of an inch in diameter is satisfactory for most purposes. The smaller sizes tend to clump together, making it difficult to pick up a single ball with the dressing forceps. Cotton is used to dry tooth sockets prior to the placement of sedative dressings. If only a small wisp is needed, as for incorporation in a surgical pack dressing, the required amount is easily picked off with the dressing forceps. Cotton balls are never used for sponging in fresh extraction wounds for many reasons, the chief one being that cotton fibers tend to catch on bony spicules and remain as foreign bodies.

Cotton rolls, number 3, $1\frac{1}{2}$ inches long, are ideal for covering tooth sockets after one or two extractions, as they have a smooth surface which does not become enmeshed with the blood clot.

Towels and Drapes. Towels approximately 12 × 24 inches will serve the several purposes of covering the patient's hair, drying the hands, and providing a clean surface from which to do brief operations or perform postoperative treatments.

Rectangles of fine muslin or Indianhead fabric 22 × 36 inches are used for covering the patient's chest, being secured with a safety pin at the back. They may also be used in assembling the flap tray, half serves as the covering for the bare tray and the other half is drawn over to cover the instruments prior to use.

Some operators like to use a much larger covering for the patient's body and still others prefer to cover the patient with a water-repellent cape over which is placed a cloth cape or drape. These are matters to be decided by the individual operator

Syringes and Needles. In addition to the carpule type local anesthetic syringe, the dentist should provide himself with a few Luer syringes of the 1-, 2-, or 5-cubic centimeter size, and needles of the 20, 22, and 25 gauge. These will be needed for an occasional parenteral injection, venipuncture, or diagnostic aspiration. They must be either autoclaved in muslin wrappings or boiled and stored dry in a sterile jar.

Items such as iodoform gauze, oxidized cellulose, gelatin sponge, thrombin, etc. are discussed in the chapter on Drugs and Pharmaceuticals, p. 353.

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6

The Seven Minimum Essentials

To achieve uniform success in the technical side of oral surgery it is important to develop good working habits. A habit is a custom or aptitude acquired by repetition and marked by facility of performance. The ultimate of perfection in dexterity is seen in the professional juggler, magician, acrobat, or athlete, who, through constant repetition of proper form and technic, comes to do the desired activity automatically.

As the prospective oral surgeon contemplates his lifetime of operative work he would do well to ponder the consequences of failing to operate systematically. Every act of the surgeon should advance the operation closer to its conclusion. An aimless, hit and miss approach to a surgical task becomes laborious, time consuming, and uncertain of result.

Some professional men feel it is undignified to standardize or routinize the method of caring for patients. To be sure, the total care of the patient cannot be carried through according to an iron clad plan, for individual differences in cases are always present. However, *sections* of the treatment lend themselves very well to standard disciplines, and the thoughtful operator is prepared to apply these separate, individual skills to his surgical problem in proper sequence.

Avoiding Accidents

Serious mishaps are rather uncommon in oral surgery, and usually are avoidable. Wasted time, fatigue of the patient and operator, and substandard working conditions are very common. Fortunately, measures taken to improve either of these two situations help both, so there is a double reason for striving for optimum working habits and facilities. Increased efficiency takes effort, thought, planning, and some added cost, but it is a goal that must always be kept in mind.

As efficiency improves, it may be confidently anticipated that accidents, operating time, and trauma will be reduced, and there will be a proportionate increase in the pleasure of operating.

Possible Methods of Solution

As the various things are contemplated which might help to achieve more efficiency in operating, the following possible measures come to mind:

1. *More Assistance.* Up to a certain point more competent assistance helps. This limit is seldom reached in practice because of (*a*) the cost of salaries, and (*b*) the labor of training assistants.

2. *Automatic Instruments.* The electric dental engine, suction aspirator, automatic chisel, and other devices all have their place if the added expense and practicability justify their use.

3. *Painstaking Preparation and Planning of Operation.* (*a*) A complete diagnosis—history, examination, radiographs, medical opinion, etc.—is mandatory. (*b*) When indicated, a review of textbooks or periodical literature to determine the best procedure may be done. (*c*) The patient may be prepared with information and with drugs.

4. *Avoiding Unnecessary Motions.* This takes discipline, a methodical temperament, and means working in steps.

5. *Working by Direct Vision.* This is achieved by adequate opening up of the wound, maintaining a bloodless field, and having brilliant illumination on the field 100 per cent of the time.

At the University of Minnesota, the essence of all these ideas has been formed into a basic set of operating conditions which are known as "The Seven Minimum Essentials."[1,2] Although originally adopted for tooth removal operations, they have come to be regarded as a "check list" or set of standards for all oral surgical work, whether it is performed under local or general anesthesia, and whether it is conducted in the dental clinic or hospital operating room.

Nurses and other auxiliary personnel thrive on routine and standardization. When plans are definite and clear-cut these individuals can go ahead and make preparation for surgical tasks without delay.

These are the seven minimum essentials:

R 1. *Radiograph:* a clear, recent radiograph of the tooth and some of the surrounding structures.

A 2. *Anesthetic:* a suitable anesthetic agent for the task at hand.

F 3. *Forceps and elevators* appropriate for the teeth to be removed.

F 4. *Flap Tray:* a tray of instruments for performing flap operations, sterile, ready.

L 5. *Light:* brilliant illumination on the site of operation 100 per cent of the time. This is best achieved with the headlight.

E 6. *Efficient assistance* throughout the entire operation, on *every* operation.

S 7. *Suction aspiration.*

For ease in memorization the initial letters have been arranged to form a key word.

1. *Radiograph.* No tooth extraction operation should be attempted without a clear, recent radiograph of the tooth and some of the surrounding area. Time taken to secure a good radiograph is not wasted but on the contrary is a good investment in safety and efficiency.

The dentist must firmly believe in the principle of invariably working from radiographs if he is to convince his patients that it is

essential. Some patients are astonished at the thought of wasting an *x*-ray on a tooth which is about to be sacrificed. The dentist should refuse to operate if an understanding cannot be reached on this point.

Operating with the constant advantage of good preoperative pictures does many things. It gives a good view of the shape, size, and curvature of the root, the density of bone, the presence of pathological processes such as cysts, tumors, or fractures that may not have been suspected, and it verifies the clinical diagnosis of the condition of the tooth itself in matters of depth of caries, location of pockets, and so forth. It is a black and white permanent picture record proving that the tooth required extraction, should the question ever come up at a future date.

2. *Anesthetic.* The anesthetic agent used for any operation must be *suitable* for the case at hand. The dentist himself must decide which is proper. The patient's whim or caprice must never be the deciding factor. It is a good plan to ask the patient if there is a preference for any particular agent, and if the choice is suitable, there is no problem. On the other hand, if there is disagreement between the patient and operator the difference must be resolved. The important things are that this factor be considered in advance and the best agent selected.

Guides for the Selection of a Suitable Anesthetic Agent.

(*a*) General anesthesia is to be preferred:

- (*i*) For children six years of age and under, and for those above six who are extremely apprehensive.
- (*ii*) For brief procedures such as incision and drainage, or the extraction of a single tooth, in the presence of acute infection.
- (*iii*) For patients who are sensitive to or allergic to some component of the local anesthetic solution.
- (*iv*) For prolonged operations on patients whose physical or mental condition would be inadequate to give the surgeon ideal working conditions. These patients should be cared for by intratracheal anesthesia in the hospital operating room.

(*b*) Local anesthesia is to be preferred:

- (*i*) For removal of impacted and unerupted teeth.
- (*ii*) For multiple extractions and alveolectomy.
- (*iii*) For extractions requiring tooth division or surgical removal.

The use of Nembutal or Seconal orally, rectally, or intravenously as a premedication may permit satisfactory work on patients who originally appeared too apprehensive to undergo oral surgery under local anesthesia.

3. *Forceps and Elevators.* It is self evident that for tooth removal procedures suitable forceps and elevators must be available and ready for use. The choice of extraction instruments poses little problem when one has mastered the proper method of use of each

and has become familiar with the features of instrument design which give greatest efficiency.

4. *Flap Tray.* This is a standard enamel or plain metal rectangular surgical tray, obtainable in various sizes. On it is laid a sterile towel, and upon this is arrayed a set of instruments of proven worth, 12 to 14 in number, all carefully sharpened, oiled, sterilized, and ready to use. The tray is kept covered with a sterile cloth when not in use. Figures 65, 66, and 67 indicate the method of converting from the simple extraction setup to the complete instrument array for performing flap operations.

It is important to have the setup *always the same*, and to that end it is wise to have a typed list of items on the wall above the work space where the tray is assembled so that the assistant may check them. A missing instrument may hold up an operation at a crucial point. A stack of two or three of these trays is desirable if one is doing any amount of oral surgical work at all, and the outlay will prove to be no extravagance.

The flap tray is the only essential that is not put into active use on every case. It is held in readiness on such cases as single extractions of uncomplicated teeth, to be brought out at once if a root fractures or if bone removal is required. When impactions, ridge trimmings, or other more involved tasks are to be attempted, the complete tray setup is used from the beginning. The tray should be used often so that both operator and assistant become thoroughly at home with its component parts, for equipment reserved for emergencies only will seldom function when called upon.

A common tendency is to try to get along with less than this complete setup, to perhaps "steal" just one or two instruments from it without contaminating the whole tray. This is false economy and defeats the purpose. The principal idea of the flap tray is the saving of operating time by standardization of routine. Almost equally vital are the objectives of increased pleasure of operating and reduction of the patient's apprehension by the smooth flowing transition to complex surgical technics when emergencies arise. The office personnel must resign themselves to somewhat more time for washing, servicing, and setting up instruments in order to achieve the increased level of efficiency at the chair.

The following is the recommended list of instruments for the standard tray setup. It will be noted that the usual basic items of the simple extraction set are lacking, since they are invariably laid out for all tooth removal operations.

(*a*) Scalpel with number 15 blade
(*b*) Retractor
(*c*) Chisel
(*d*) Mallet
(*e*) Gilmore probe
(*f*) Rongeur forceps or side cutting bone forceps
(*g*) Two number 560 crosscut fissure burs
(*h*) Bone file

(*i*) Tissue forceps
(*j*) Suture, needle, and needle holder
(*k*) Scissors

5. *Light.* Brilliant illumination on the field of operation at all times is imperative. There are many rational arguments for the use of the *headlight* as the only agency that can meet these criteria. It eliminates the possibility of shadows caused by the operator's head, it permits variation of the direction of the beam when the patient's position changes or when a small cavity such as a tooth socket must be illuminated, and it obviates the necessity for holding a small light within the mouth for difficult tasks.



FIG 75 Illustrating how head of operator may block beam from fixed light

The beam from the headlight should arise from a point as near as possible to the eyes, so that it is parallel to the line of vision and able to pass to the operative field without producing shadows from the patient's cheeks or lips. In other words, "the eye must see along the beam."

Figure 75 illustrates the salient advantages of the headlight over a fixed light placed back of the operator. There are other less obvious but none the less important advantages of the headlight. The spot may be kept small enough so that all of the light passes into the oral cavity, with none illuminating the patient's face. The analogy is to the brightly lit theater stage when the house lights have been put out. Another advantage is that the center of interest, the operative field, is illuminated only when the operator is focusing his attention on the operation. He is therefore under some pressure from the assistant to tend to business and get the job done!

There are now several very good types of headlights on the market. The least expensive, which is sold as a camper's light, draws its current from four dry cell flashlight batteries. It is made by the Justrite Manufacturing Co. and sold through the mail order department of the Montgomery Ward and Co. This same manufacturer sells a light with a similar head but a larger case which holds a 6-volt lantern battery. In each type the battery case is worn on the belt,

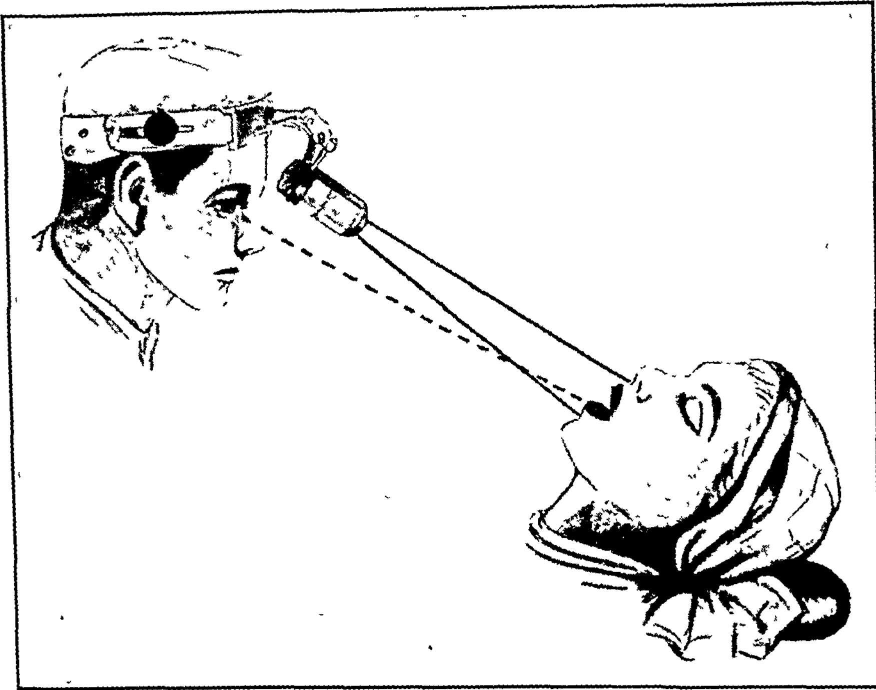


Fig 76. Illustrating advantages of headlight over fixed light operator's head cannot block beam, illumination may be confined to oral cavity, and beam is always nearly parallel with line of vision



Fig 77 Correct manner of wearing headlight; beam emerges from region of glabella (National Electric Co, Elmhurst, Long Island, N Y)

permitting the operator to walk about, carrying his illumination with him.

Lights of the plug-in variety, which draw their 6-volt current from a rheostat or resistance coil, are made by the National Electric Co., Hu-Friedy Co., and Goodlight Co. The prime advantages of this type are the constancy of intensity of light and economy in the cost of the electricity. The disadvantage is that the operator cannot move any great distance from the chair without disconnecting the wire leading from the rheostat.

6. *Efficient Assistant.* Attempting to do oral surgery alone is a vicious practice and invites accidents, frustration, and wasted energy. It has been truly said that the dentist is the most expensive

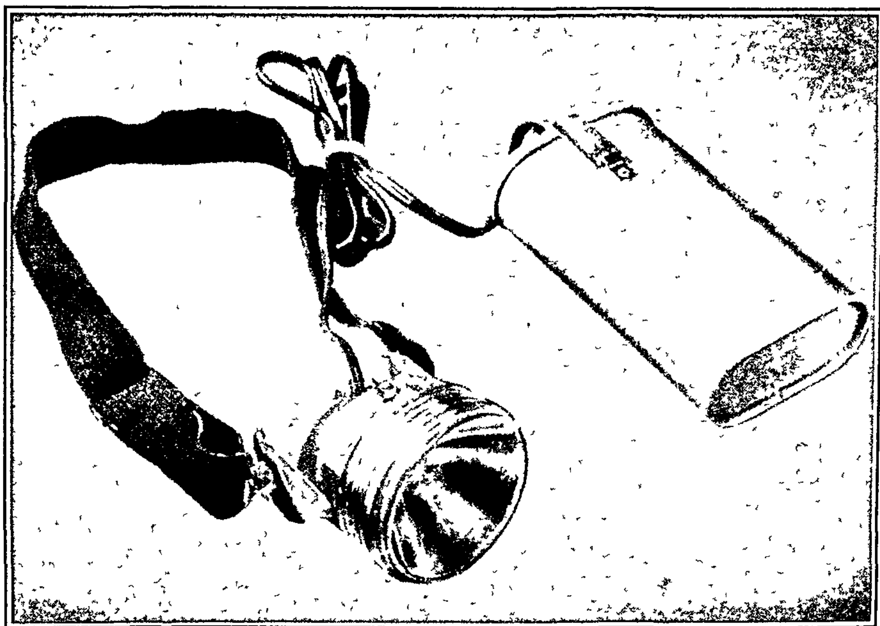


FIG 78 Four-cell battery type light (Justrite Mfg. Co, Chicago)

piece of equipment in the dental office. His background, training, and skill must be kept working at peak efficiency. The use of an assistant is mandatory, and she should be well trained in the specific functions and hand motions that will be required of her. They are to:

(*a*) Use the suction aspirator constantly to remove blood, saliva, and débris from the floor of the mouth, the dorsum of the tongue, the right and left retromolar triangles, and the wound itself. If this duty is faithfully performed the patient should never have to use the cuspidor, and the operation proceeds more rapidly and far more neatly. If the aspirator tip becomes plugged she must instantly clear the obstruction with the cleaning wire.

(*b*) Use the water syringe (in conjunction with the aspirator) to cool the bur or clear a film of blood from the surface of bone. This should be done without a specific request from the operator.

(c) Use the 3 × 3 inch gauze square in the left hand to receive débris picked up by the aspirator tip and to clean the beaks of instruments such as the rongeur forceps or side cutting bone forceps. A fresh sponge is taken from the pile on the table as needed. The gauze should be firmly placed against the wound if the aspirator becomes plugged, to keep the field dry until the obstruction is removed.

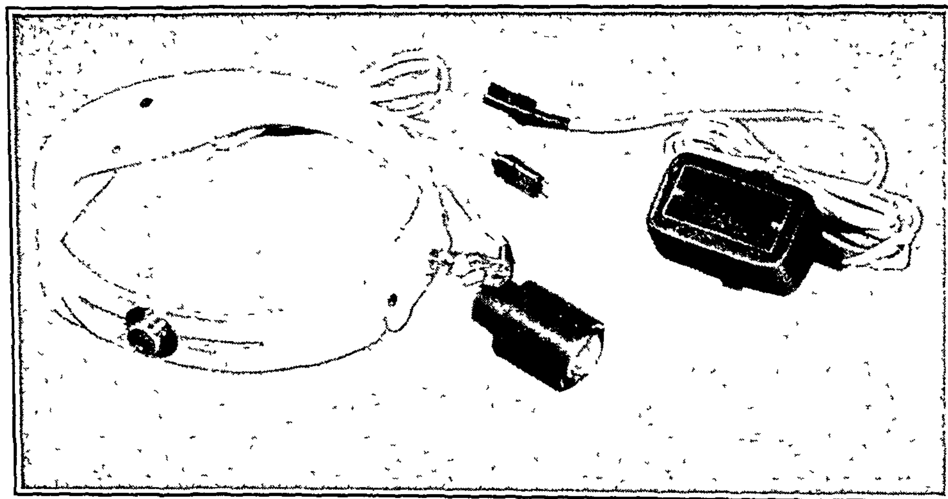


Fig. 79. National Electric Co headlight, which employs house current



Fig 80 Operating with the Seven Minimum Essentials

(*d*) Take the retractor to hold back the lip or cheek at the moment when suture knots are about to be tied.
(*e*) Mallet with the left hand.
(*f*) Reassure the patient with a pleasant, affirmative manner.
It should not be necessary to emphasize that when scrubbed for an operation she must remain at the chairside until the completion of the procedure. An additional nonsterile attendant is highly desirable, to answer the telephone, receive and discharge patients, and procure items of equipment which might be needed during the operation. To realize the maximum benefit from the extra pair of hands one must use them always.

7. *Suction Aspirator.* This is perhaps the greatest contribution to oral surgical technic in recent times. It comprises an entirely new concept in operating. Formerly, many of the arm and hand motions of the operator or assistant were devoted to sponging with cotton or gauze. By the use of the aspirator a bloodless field is maintained effortlessly and effectively throughout the entire operation. The hands are released to perform productive work.

The source of suction may be from a simple chemist's filter pump fitted to a faucet, an electrically driven pump, or a hospital wall type suction. The author's preference is for the latter, as it has no moving parts, has no trap to be emptied, and the first cost is the last. When the amount of use and available space permit, a central electric pump with several outlets makes a strong, effective system. The original expense is rather sizable, however.

These Seven Minimum Essentials must be used on every oral surgical procedure. In the various operations decribed in subsequent chapters, it may always be assumed that these facilities are present and functioning. They are equally essential in the dental clinic, office, or hospital operating room.

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1 Clark, H. B., Jr., and Clark, H. B Minimum essentials for tooth removal operations, J A D A , *27*, 571, 1940
2 Clark, H B , Jr : The seven minimum essentials for tooth removal operations, J Wisconsin Dent Soc , *25*, 155, 1949

7

Basic Oral Surgical Technic

SOFT TISSUE SURGERY

INCISION

Instructions for the use of the scalpel should be reviewed. It must be emphasized that for maximum effectiveness and control, soft tissues must always be immobilized, tensed, or stretched whenever they are to be worked upon with *any* sharp instrument.

For incision and drainage, if the purulent fluid is just beneath the surface of the skin or mucous membrane, the number 11 blade may be used in the outward cutting manner previously described. If the fluid is believed to be at some depth, the number 15 blade is used in the conventional manner for making any incision just through mucous membrane. Further entry is made by blunt dissection with the hemostat or Mayo double blunt scissors (see Fig. 81*D*.) As all the vessels are usually engorged in areas of acute infection, even blunt dissection may be accompanied by free hemorrhage for several minutes after the tissues have been opened. No sharp dissection should be carried into the depths of the wound unless all facilities are available for open surgical dissection and hemostasis.

It is usually wise to insert a strip of rubber dam drain to maintain the patency of the tract and thus permit egress of all purulent material. Such a drain can be introduced easily by the use of a flexible, blunt, silver probe, as shown in Figure 81*E* and *F*.

Sharp dissection is the key to success in the more major oral surgical procedures around the jaws such as open reduction of fractures and mandibular resections. It insures rapid, atraumatic opening up of the wound and provides the widest possible exposure. The soft tissues being stroked with the number 15 scalpel blade must be under tension provided by retractors or hand pressure with the aid of a gauze sponge. Blood vessels, nerves, and other important structures can be viewed and dealt with prior to severance by the blade. The scalpel strokes should be long, steady, and made with fairly light pressure; the tissues will fall apart as the knife passes over them.

The removal of *calculi* which lie in that portion of the *submaxillary salivary duct* which is above the mylohyoid muscle (see Fig. 82) presents no difficulties when good surgical principles are followed. The stone can often be felt upon bimanual palpation. Infiltration local anesthesia is established; the needle may grate upon the cal-



FIG 81 Incision and drainage *A*, Preoperative appearance, *B*, local anesthesia, *C*, incision, *D*, hemostat inserted and beaks opened (purulent fluid escapes), *E*, rubber dam drain stretched over flexible probe, *F*, probe withdrawn Drain remains in wound.

culus as the injection is being performed. After a 1- or 2-centimeter incision directly over the duct, traction sutures are inserted at each side of the wound, and the sharp dissection continued downward, with the tissues on good tension, until the stone is encountered. After generous incision of the duct itself the stone is removed care-

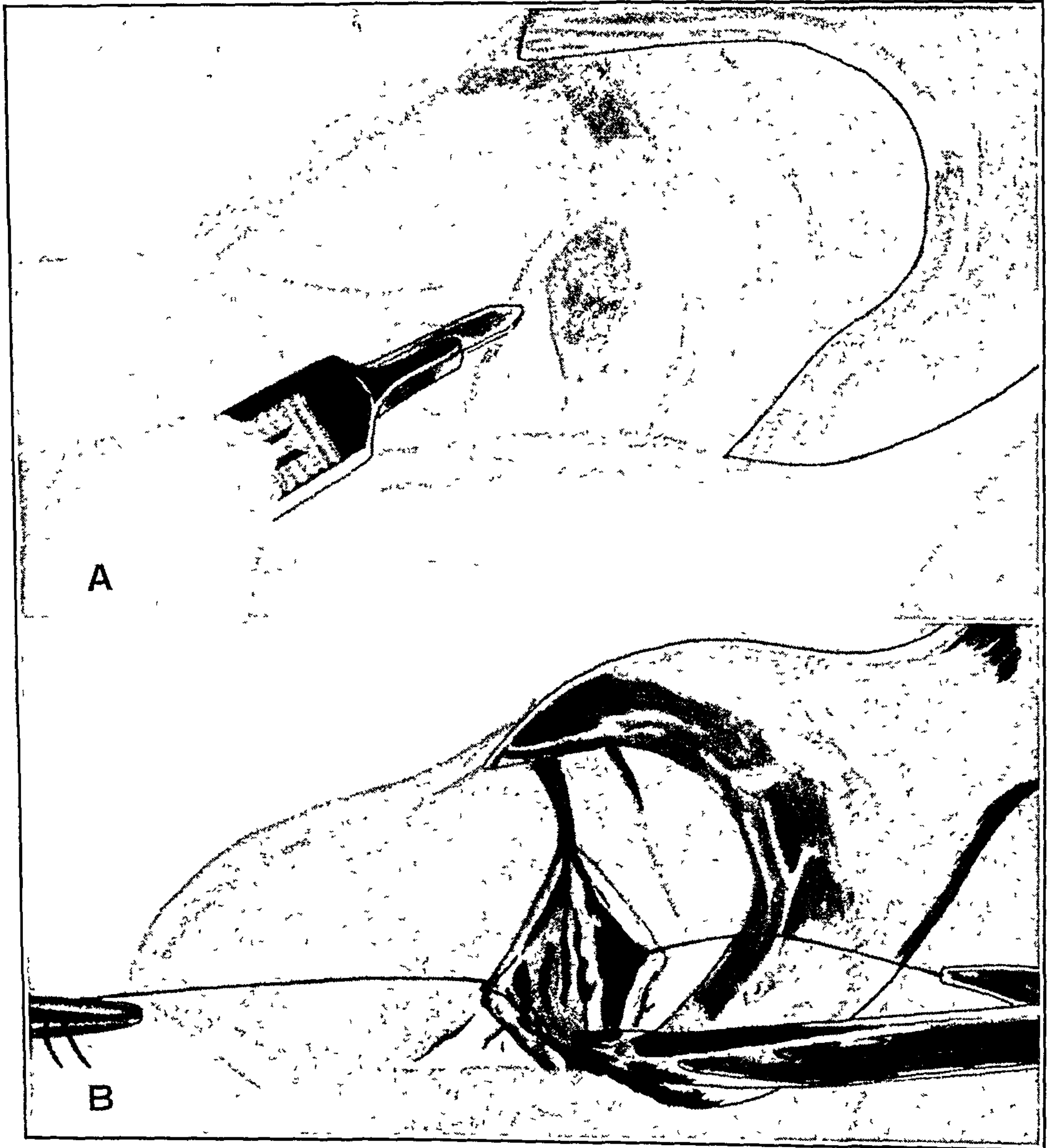


FIG. 82. *Legend on following page.*

fully with the broad end of the number 7 wax spatula or with the nasal dressing forceps.

As these stones are frequently quite soft, a vigilant search should be made for small particles which may remain after the bulk of the mass has been lifted out. Postoperative occlusal plane radiographs should be taken to make certain that removal is complete, for a tiny



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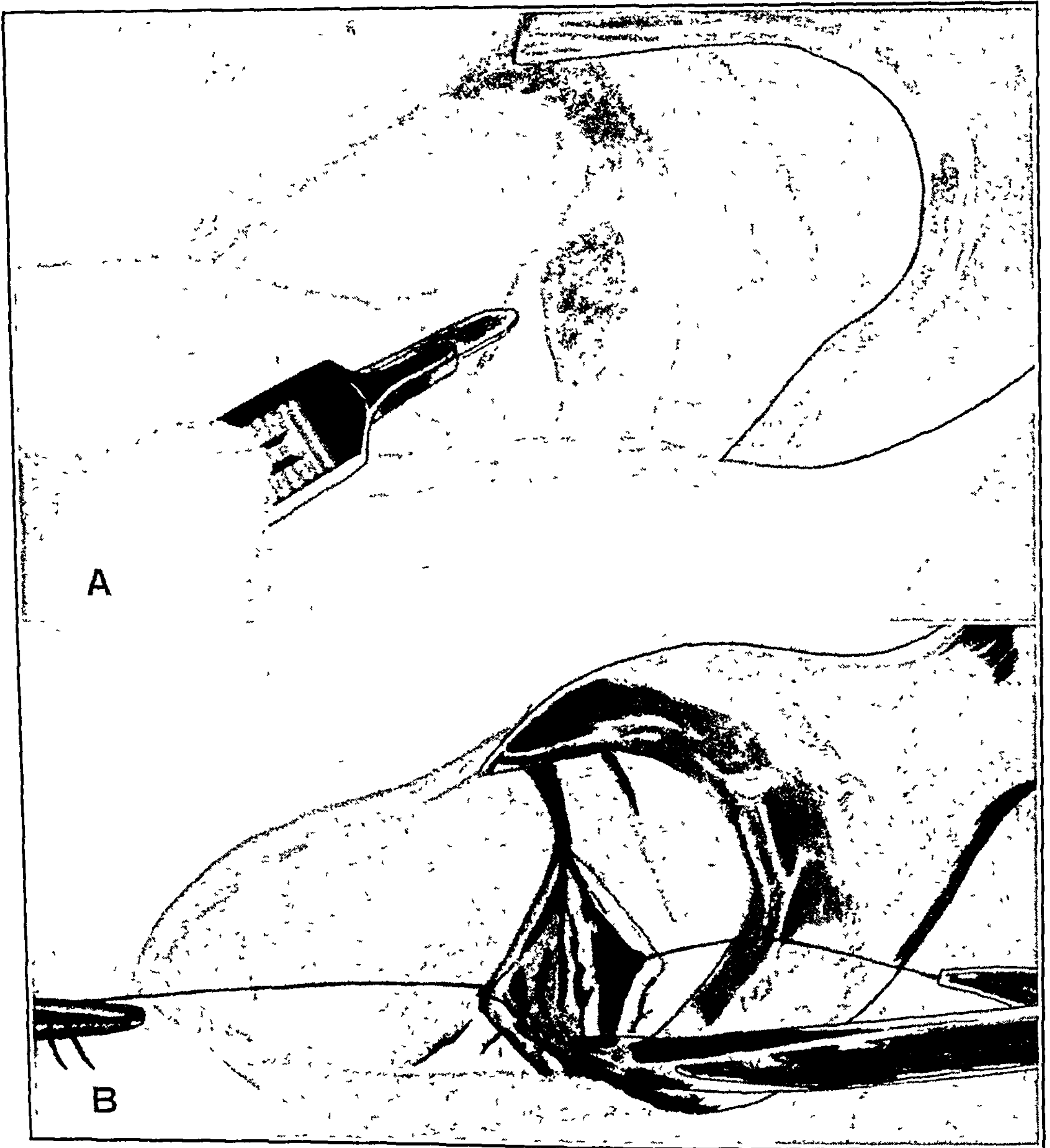


FIG. 82. *Legend on following page.*

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particle of foreign material is as likely to give symptoms as a large one. The wound may be left open or sutured, with care being taken to avoid ligating the duct, particularly proximal to the surgical opening.

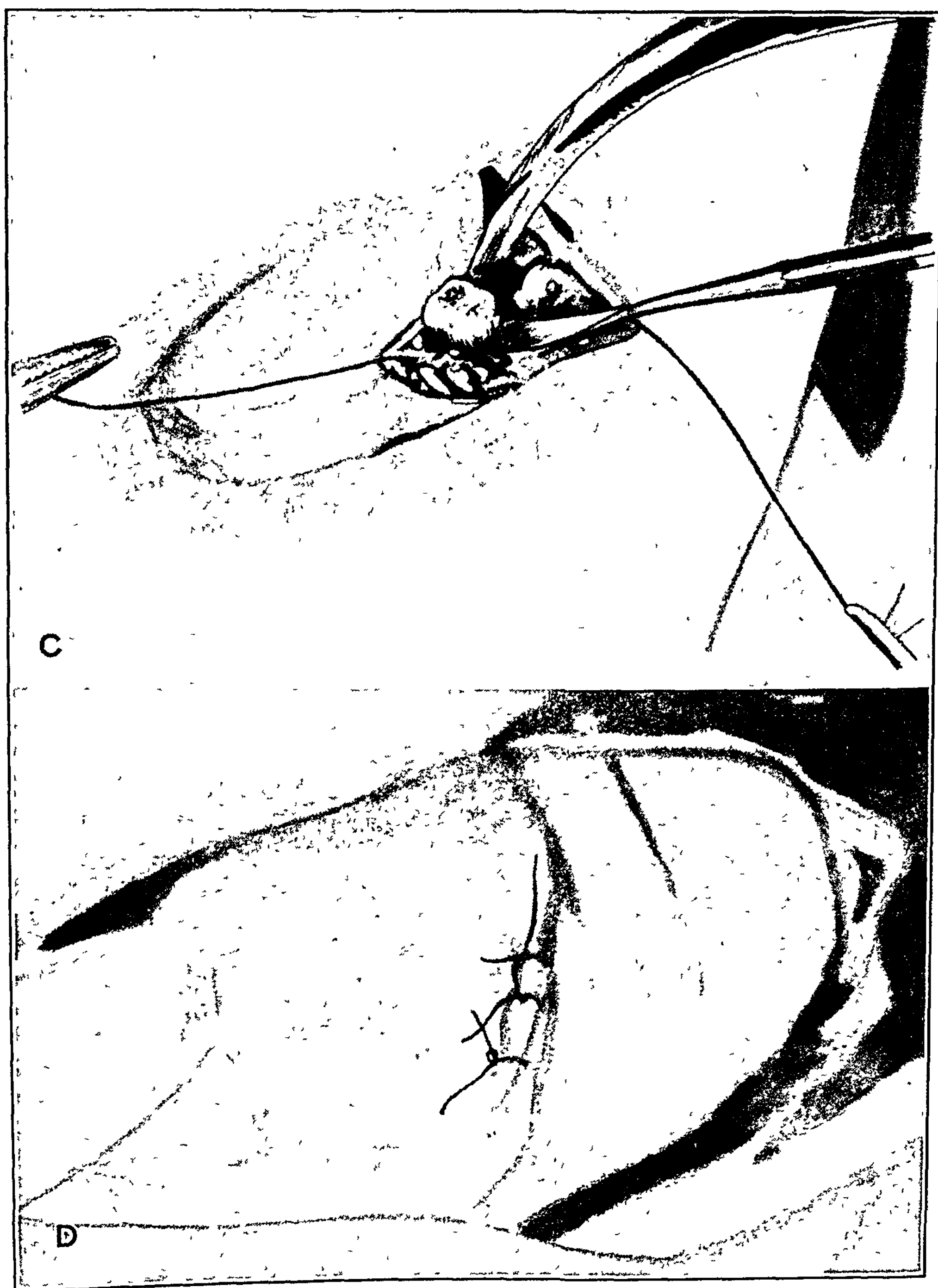


FIG 82 Removal of submaxillary stone.
A, Incision; *B*, exposure by aid of traction sutures; *C*, removal of stone; *D*, closure

EXCISION

Most tissues which will be excised during the course of oral surgery are attended by sufficient interest that they will be submitted for histological study in the pathology laboratory. These suggestions are therefore equivalent to instructions for performing an *excision biopsy*.



FIG 83 Excision of polyp. 1, Preoperative appearance; 2, anesthesia; 3, incision; 4, traction; 5, severance; 6, suture (courtesy of North-West Dent.)

When the lesion is on movable soft tissue such as the inner surface of the cheek or on the tongue, it is well to plan to close the resulting defect with sutures. The incisions should therefore be planned so that closure can readily be accomplished and so designed that the linear scar will be parallel to creases or folds in the surface. This is

particle of foreign material is as likely to give symptoms as a large one. The wound may be left open or sutured, with care being taken to avoid ligating the duct, particularly proximal to the surgical opening.

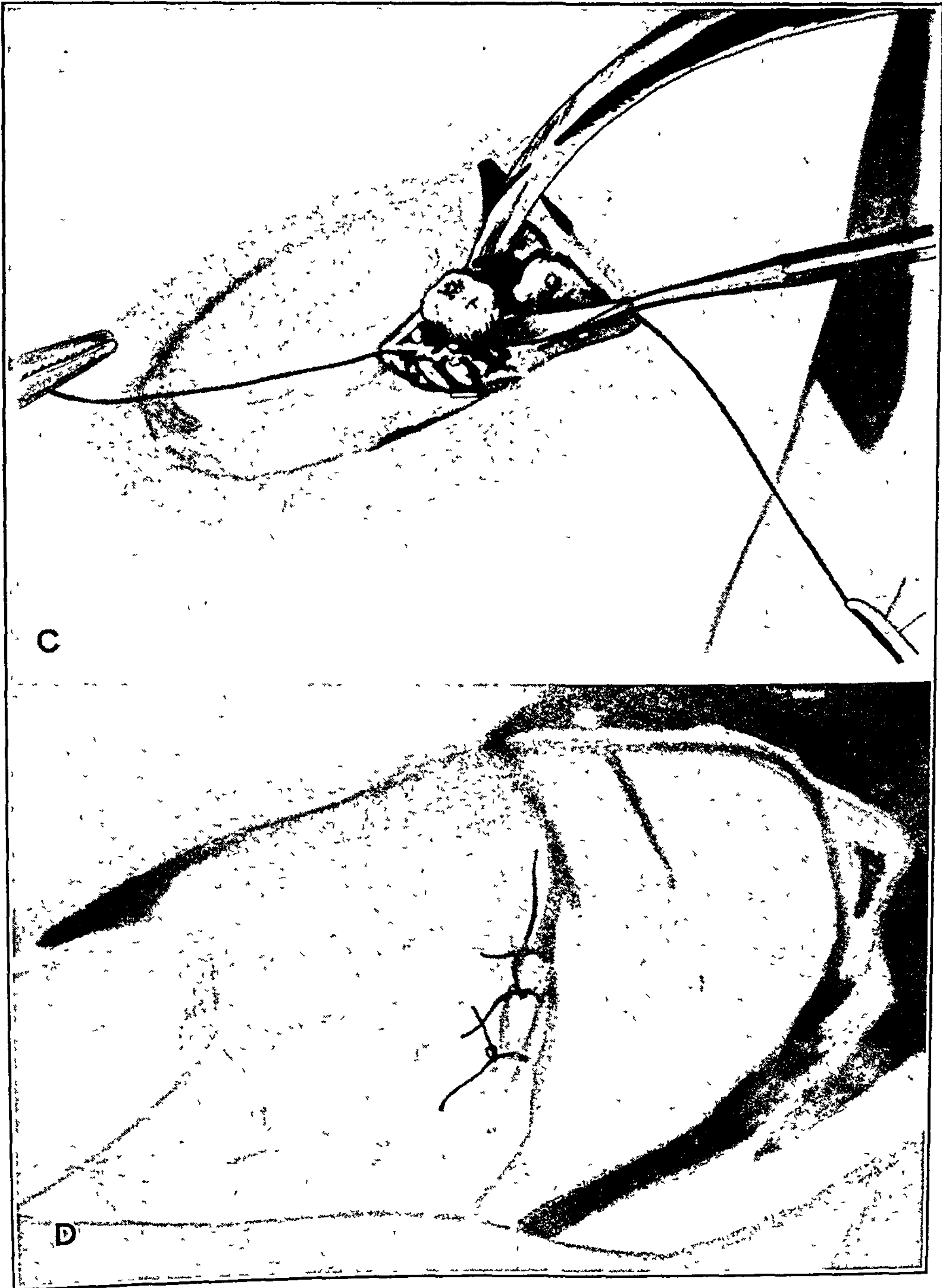


Fig. 82 Removal of submaxillary stone
A, Incision, *B*, exposure by aid of traction sutures; *C*, removal of stone, *D*, closure.



10 FIG. 84. *Legend on page 147.*

of less importance inside the oral cavity than on the face. An elliptical wound is to be preferred, with acute angles at each end, so that the margins may be drawn together without puckering.

TECHNIC

1. The tissue is immobilized and anesthesia established.
2. Both incisions are made.
3. The lesion is immobilized with a traction hook or tissue forceps, with care not to mutilate the area to be studied microscopically. The assistant makes steady traction, drawing the excised tissue away from its bed.
4. The operator snips the lesion from its attachment with scissors. The specimen is placed in 10 per cent formalin.
5. The wound edges are undermined and bleeders controlled by clamping.
6. Simple interrupted sutures or mattress sutures are inserted at intervals of 6 to 8 millimeters. Cheek and tongue sutures should be tied with 6 or 8 knots, as the constant movement of these parts causes them to loosen prematurely otherwise.

When the tissue to be excised is on the hard palate or gingiva it is impossible to close the wound without extreme undermining. It is preferable, in these cases, to leave the wound open or to fill the defect with absorbable oxidized cellulose.

In conveying the specimen of tissue to the bottle of formalin it should be remembered that the bottle is not sterile. No contact should be made with instruments which are to be used for the remainder of the operation.

When the *biopsy* is to be made of only a portion of a large lesion it is important that a representative area be sampled. Since carcinoma is the possibility of major interest, it is customary to remove tissue from the margin of the lesion, including some normal and some abnormal material. The central portion may be necrotic and valueless for microscopic examination. Tissue should be removed to a sufficient depth to permit study of the degree of penetration.

FLAP ADVANCEMENT

A common pitfall in attempts to close surface defects is a failure to provide sufficient relaxation of soft tissue margins which are to be drawn together with sutures or moved to a new location. Human tissues have the quality of contractility, common to all protoplasm. It may be taken as an axiom that whenever tissues are sutured with too much tension the stitches will cut through and the wound will gape open. This occurrence is always undesirable, for at the least it may leave bare bone exposed and greatly prolong healing. In crucial situations such as the closure of an antra-oral fistula it will immediately spell the doom of the whole operation.

The following steps are common to all flap advancement or rotation procedures:

1. The flap should be outlined mentally with serious consideration to ample size, adequate blood supply, vital structures lying beneath, and position to which it is to be moved.
2. The incisions are made.
3. Undermining is performed through the submucosal layer.
4. With traction hooks or tissue forceps the flap is drawn to its new location and beyond. If there is too much tension, further undermining must be done. The points which impair relaxation should be directly visualized and completely severed.
5. Bleeding is controlled.

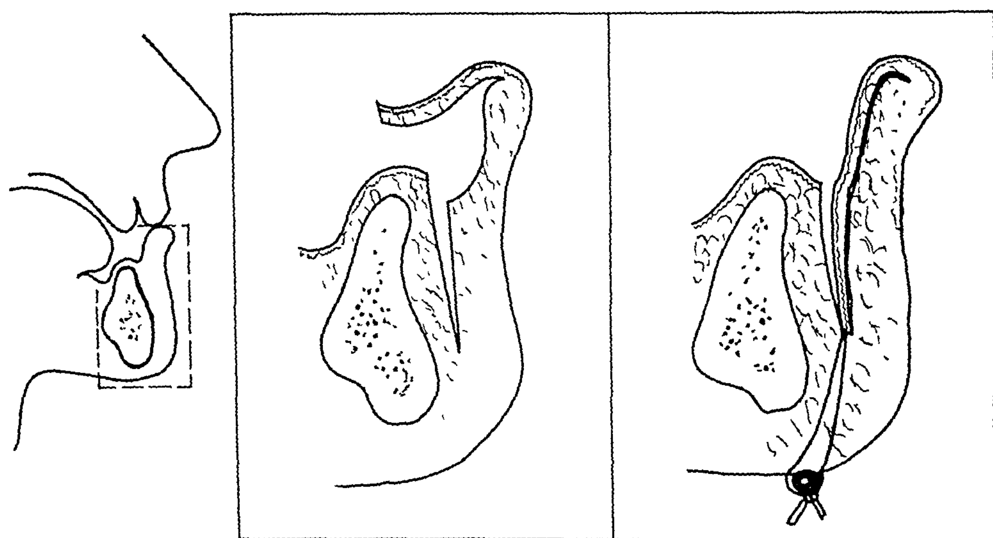


Fig 84*G*

Fig 84. Deepening of labial sulcus by labial flap advancement *A*, Preoperative appearance; *B*, incision; *C*, undermining; *D*, flap ready for advancement; *E*, margin of flap carried to depth of new sulcus; *F*, sutures passed through skin and tied over rubber tubing; *G*, scheme of operation (Clark, courtesy of J Oral Surg).

6. The flap is sutured to its new bed with carefully placed interrupted stitches. One or two mattress sutures may be indicated to appose accurately raw to raw surface over a sufficient area to insure early establishment of circulation from the new bed.

HARD TISSUE SURGERY

Extraction of Erupted Teeth

The Simple Extraction Concept

When all evidence indicates that a tooth removal procedure is going to be simple, all activity and technic should be consistent with that theme. There are two cogent reasons for this:

(*a*) Most patients fervently hope that the removal of their offending tooth will be brief and simple. They anticipate a minimal fee for the service. They are not anxious to have the dentist give a masterful display of the many oral surgical skills he may possess.

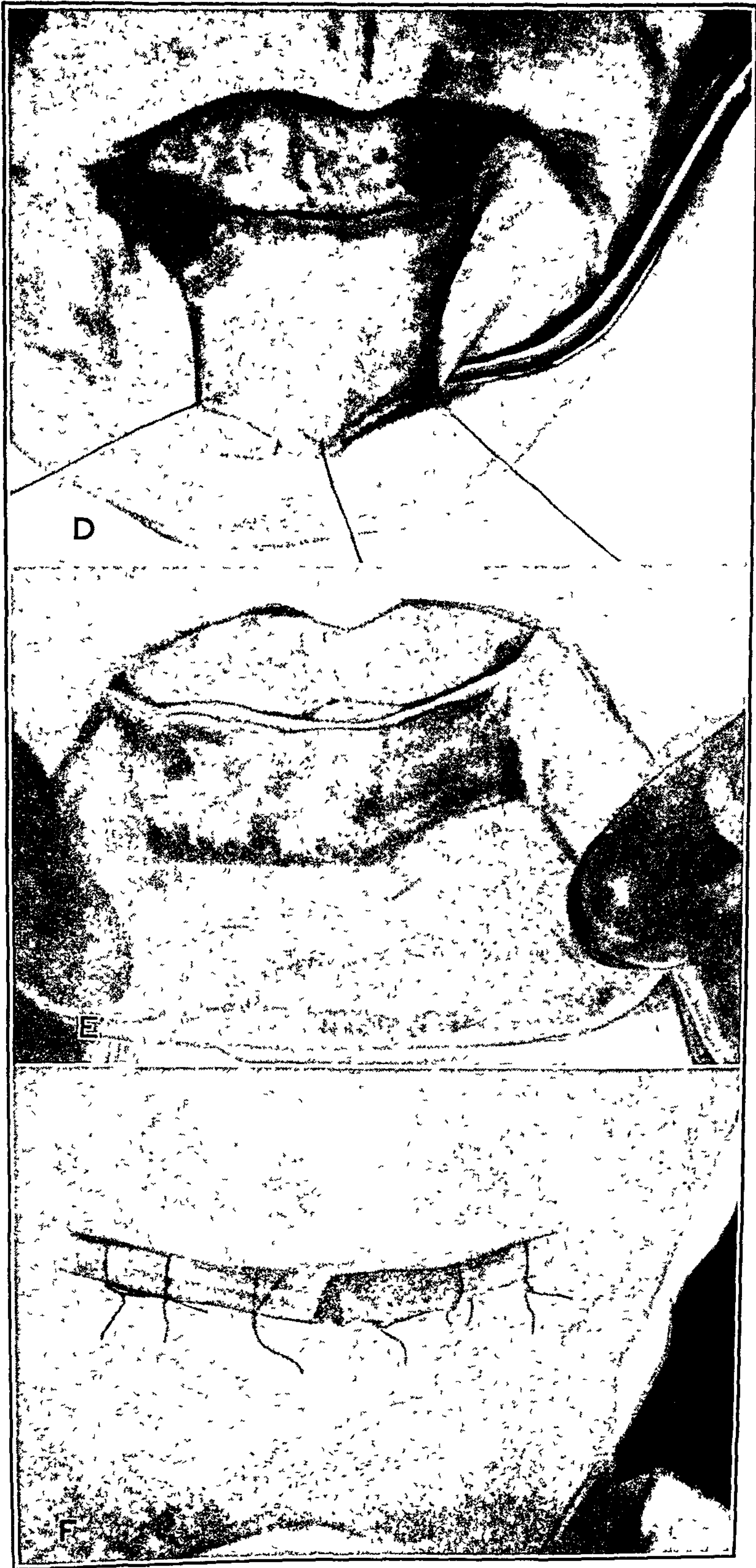


FIG. 84. *Legend on page 147.*

11. If, after a reasonable application of force for one or two minutes there is no movement whatever, it is probable that tooth sectioning or a flap operation will have to be done. The use of severe unbridled force may result in an explosive extraction, with mutilation of bone and soft tissues.

12. When considerable mobility has been produced, gentle traction should be applied to lift the tooth from the socket.

13. The tooth should then be inspected with a dry sponge and strong light, to determine whether root fracture has occurred.



FIG. 85 FIG 86

FIG. 85 Extraction of upper anterior tooth (rotation emphasized)
FIG. 86. Extraction of upper bicuspid (bucco-lingual movement emphasized.)

14. The socket and adjacent soft tissues are examined carefully and the alveolar wound compressed firmly with the thumb and forefinger. The socket opening is explored with the double-ended curet. Loose bone particles, tooth fragments, and bits of calculus or filling material are removed. The curet is not used in the depth of the socket except for some specific purpose such as removal of a granuloma.

15. In simple extraction cases it is not considered good practice to flush out the socket with water, as the virgin clot is felt to offer the best prospect for primary healing.

16. Suturing of a simple extraction wound is a purposeless gesture, for successful closure cannot be accomplished unless the tissues are relaxed by undermining to permit closure of the soft tissues without tension.

(*b*) The dentist is in a position to make a very favorable impression on the patient. Simple extractions are generally followed by an uneventful recovery, devoid of pain, swelling, stiffness, and ecchymosis. The layman's opinion of a dentist's skill in oral surgery is often formed on the basis of the amount of postoperative difficulty. When there is proper justification for a more traumatic procedure the patient should always be warned in advance about the probable sequellæ.

In view of these considerations, the dentist should plan for a procedure that is brief and simple but which fulfills the requirements of a painless operation, thoroughly performed. He should keep his mind on the objective of the operation—the complete removal of a diseased organ, in the shortest period of time compatible with the requirements of total anesthesia and total removal of the tooth.

General Instructions for the Use of all Extraction Forceps

The extraction forceps is the instrument of choice for removal of teeth. Elevators are excellent tools for their purpose, but should be reserved for special situations where there is insufficient crown structure remaining to permit use of the forceps, or where the tooth is submerged, crowded, or irregularly placed.

1. The patient should be seated comfortably in the dental chair in a position that will give the best access to the area of surgery. In general the chair should be low for removal of lower teeth and high for removal of uppers. The occlusal plane of the lower teeth should be parallel with the floor when the mouth is opened, to give best access to both upper and lower arches.
2. The forceps is held in the right hand with the beaks directed away from the operator. All fingers encircle the handles with the exception of the fourth, which provides opening movements of the instrument as the tooth is being grasped.
3. When possible the thumb and forefinger of the left hand should grasp the alveolar process. In some cases these fingers can steady or guide the beaks into position.
4. The lingual beak is placed in position and held there.
5. The buccal (or labial) beak is allowed to come into contact with the crown at the desired point.
6. The fourth finger is now allowed to encircle the handles to permit a stronger grasp.
7. When the beaks are well seated, the handles are closed very firmly to prepare for application of the luxating force.
8. (See specific extraction technics, which follow this section.)
9. As the various forces are applied, sharp attention should be given to note in which direction the tooth moves most easily. It should be extracted in the direction toward which "it wants to go."
10. The tooth may be expelled rapidly from its socket as the beaks snap shut. This occurrence denotes no fault in technic but simply the highly effective double inclined plane effect of the opposing blades of the instrument.

peated with increasing force. Slow, forceful movements of this type give the periodontal membrane fibers time to break and the socket walls time to yield. The analogy is to warm modelling compound flowing under sustained pressure. Rotation gives a high degree of power and control.

Labiolingual (or buccolingual) movements may be used, but root fracture or explosive extraction are more likely to occur by this method.

Single Rooted Teeth with Flattened Roots. The four lower incisors and the upper second bicuspid comprise this group. Occasionally the first bicuspid may have a single flattened root.



FIG 89 FIG 90

FIG 89. Extraction of lower bicuspid (rotation emphasized)

FIG 90 Extraction of lower molar with English type forceps (buccolingual movement emphasized)

The labiolingual (or buccolingual) movement is accentuated. Occasionally slight rotation or inclination in the direction of root curvature may be used to advantage.

Excessive lateral traction on slender roots will invite root fracture. Rather more than the usual amount of drawing straight out of the socket may be used in such a case, but the forceps should be effectively braked or the opposing teeth heavily padded to prevent injury, in case the tooth gives way suddenly.

If it appears that root fracture is likely to occur, as with very slender, curved roots, recovery will be facilitated by preliminary gentle loosening of the tooth.

17. The application of disinfectants to the surface of the wound is equally pointless.

18. If there is a bony prominence of some portion of the socket margin the decision must be made whether to leave it alone, in keeping with the spirit of the simple extraction operation, or whether to formally trim it, *i e.* do a flap procedure. It is unwise to attempt to snip or rasp off a bony margin by working through the socket opening. The usual result is that the mucosa becomes lacerated, and in the very worst place—right over the bony prominence!

19. The operation is concluded by placement of a moistened cotton roll or folded gauze compress over the wound, and requesting the patient to "close and hold" for twenty minutes.



FIG 87 FIG 88

FIG 87. Extraction of upper molar (bucco-lingual movement emphasized)

FIG 88 Extraction of lower incisor (labio-lingual movement emphasized)

SPECIFIC EXTRACTION TECHNICS

Careful study of the radiographs will usually permit classification of the tooth in one of the following categories:

Teeth with Cone-shaped Roots. The six upper anterior teeth and the lower cuspid and bicuspids fall in this group in the majority of instances. Occasionally the upper second bicuspid or the upper or lower third molar may develop this form. Less commonly the upper or lower second molar may have cone-shaped roots.

The extraction motions for this group are purely rotatory. Strong, sustained movements lasting five or ten seconds each should be applied in sequence, first counterclockwise, then clockwise, then re-

this thoughtfulness, and unnecessary trauma to the joint will be avoided.

Deciduous Teeth. From the standpoint of pure technic, the extraction of deciduous anterior teeth is simplicity itself. A single sustained rotation force in one direction will usually suffice to remove the tooth intact. Extraction of the posterior teeth is another matter, and when extreme divergence of the roots exists, or when the relationship to the oncoming bicuspid is unfavorable, concern must be given to the welfare of the permanent tooth. The following sequence of thoughts and steps should be applied to removal of molars of the temporary dentition:

1. All Seven Minimum Essentials should be used. The radiograph should be studied for evidence of locking of the bicuspid crown within the deciduous roots. This condition, although rare, calls for sectioning of the tooth with bur or carborundum disc, followed by removal in sections.

2. The radiograph may reveal that a root has been severed by pressure resorption of the bicuspid crown. Removal of the isolated root tip presents a difficult problem, but may be accomplished in many cases by the raising of a conservative flap and elevation with a small straight chisel.

3. In the vast majority of cases the deciduous molars, both upper and lower, may be readily extracted with a bicuspid or molar forceps of the regular set, by means of buccal and lingual forces, plus gentle traction. In the case of lowers which have moderately diverging roots, removal intact can often be performed by adding some rotation when the tooth has been tilted buccally.

4. When a relatively small root fragment is retained after attempted removal of a deciduous molar on which resorption has been nearly completed, it is unwise to embark upon an extended operation for removal. Kronfeld[1] has shown that these root surfaces are often joined inextricably with bone as a result of alternate resorption and deposition of new bone. It is highly probable that such minute root fragments will be resorbed along with the overlying bone as the bicuspid erupts.

5. It is seldom wise to curet the gum boil which is frequently present beneath and to the buccal of the extraction wound. There is every reason to anticipate prompt resolution and healing of this tissue following removal of the foreign body which caused and maintained it. The blind use of the curet is very likely to tear the pericoronal sac of the bicuspid and possibly to result in incomplete calcification of its crown.

The Open Beak Method. The student must be prepared to face adverse exodontic situations with equanimity but must be armed with effective technics in order to accomplish his objectives successfully and promptly. The method about to be described invites criticism from those who would hold that it is mutilating or unjustifiably traumatic. Actually it is neither, and can be defended firmly on several specific points. The technic will be described, then more

Multirooted Teeth. This group is made up of the upper first bicuspid and all of the upper and lower molars, when they follow the usual pattern of root form. Occasionally the lower cuspid may have a double root.

The predominant movements to be used are buccolingual, with vigilant attention to see in which direction the tooth yields more easily, so that this movement may be accentuated.

Special mention should be made of the use of the cowhorn forceps for removal of lower molars with two well-separated roots. This is the only variation from the general rule that all extraction forceps are essentially grasping instruments with some element of the double inclined plane effect. Even the upper cowhorn forceps functions essentially as a grasping instrument with a three-point contact to minimize slippage.



Fig 91 Extraction of lower molar with cowhorn forceps (handles rotated to give bucco-lingual movement of tooth)

In the case of the lower cowhorn forceps the action is somewhat different. As the buccolingual, rocking forces are applied, any one of three things may occur, each of which is a favorable development: (1) the tooth may be extracted, (2) the crown and one root may be removed, or (3) the roots may be divided and loosened.

If the beaks jam and do not appear to be sliding into the grooves leading into the bifurcation, a slight rotation may be introduced to better guide them into this concavity. Raising the ends of the handles greatly enhances the leverage effect.

In all mandibular extraction procedures, vigilant attention must be given to the amount of strain being inflicted upon the temporomandibular joints as the masticatory muscles relax during opening of the mouth. If the rocking movement appears to be excessive, a mouth prop should be placed in the contralateral molar area and the patient asked to close upon it. The patient will be grateful for

The prime advantages of this somewhat unconventional procedure are:

1. It requires a minimum of instruments.
2. It requires relatively little operating time.
3. It preserves the integrity of the buccal mucoperiosteal blanket, the essential covering for the bony wound.

The criticisms that might be levelled at the method are that it strips up the epithelial attachment from the adjacent sound teeth and that it invites fracture of the complete buccal plate over the tooth being removed. The first point has been discussed with numerous oral histologists, oral pathologists, and periodontologists. It is their considered opinion that the procedure is justifiable and that reattachment of these tissues, in the absence of calculus or other foreign material, is to be anticipated. Separation of the soft tissues from about sound teeth is widely practiced as a step in conventional flap procedures. As to the latter point, the buccal plate often comes with the tooth in spite of all efforts to prevent it, even with the most conservative closed extraction technic. Also, it is generally agreed that this buccal bone should be removed unhesitatingly in the course of performing any routine surgical removal of a tooth or root. Lastly, the importance of the welfare of the soft tissue cannot be overemphasized. A deeply notched defect on buccal and lingual aspects of the socket is the trademark of the novice and constitutes one of the worst *faux pas* in the field of oral surgery. When lost, this tissue simply cannot be replaced and wound healing is greatly delayed, with much pain throughout the entire postoperative period. Preservation of the buccal mucoperiosteum in a good state of health insures minimal deformity of the alveolar surface. The final result is a gentle concavity.

Nothing that has been said in support of the open beak method of extracting teeth should be construed to mean that its use supplants the conventional flap procedure. Each has its indications. It is important to note that the two procedures are compatible, that is to say, one can proceed to execute a complete flap procedure very nicely if the open beak method does not prove adequate for removal of the tooth.

The Flap Operation

By tradition there is a rather sharp separation between the simple extraction of teeth—so-called "closed" extraction, and the "surgical" removal of teeth. In the preceding discussions any such sharp distinction has been played down because it implies that an uncomplicated extraction does not constitute an operation, and further, that there is something awesome about any tooth removal procedure that calls for incisions and suturing. In the past this division of types of extractions frequently has been used as the means of deciding which cases should go to the specialist. From what has been said up to now, one can see how impractical and un-

fully discussed. It is employed for teeth badly broken down on the buccal aspect of the crown, or for very solid teeth which do not yield to conventional forceps application methods.

1. The small end of the number 7 wax spatula is used to pry up both buccal interdental papillæ adjacent to the tooth to be removed. The lingual mucosa is not disturbed.

2. The spatula continues its dissection, stripping up periosteum one-third to one-half way up the root. This is to relax the soft tissue so that it will not tear during the extreme lateral displacement of the tooth.

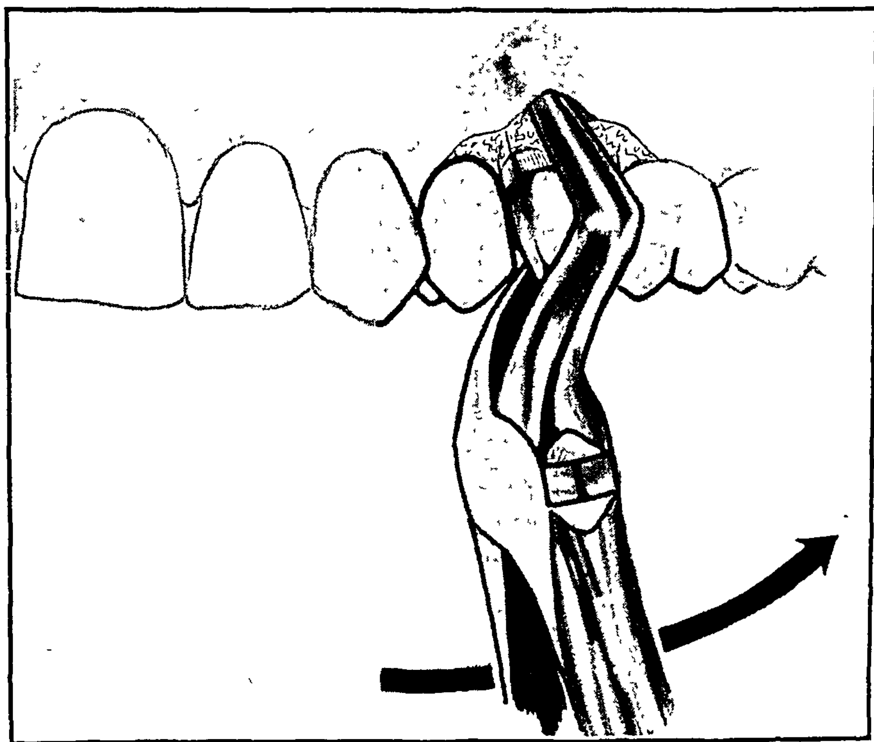


Fig 92. The open beak application of forceps.

3. In the application of the forceps, the lingual beak is applied in the usual manner but the buccal beak is placed as high as possible, resting on bone under the miniature flap. Raising this tissue with the wide end of the spatula will make placement of the buccal beak easier.

4. Steady buccal traction is applied, with the forceps still in this *open beak* position.

5. When the tooth has moved 1 or 2 millimeters the conventional grasp may be resumed and the tooth manipulated out of the socket.

6. The final care of the socket is performed as in the usual case. As a rule suturing is not necessary.

Requirements of a Good Flap

Observation of the work of many operators, appraisal of the effectiveness of their flap design, and contemplation of the final wound healing achieved has led to the following criteria which a good mucoperiosteal flap must possess:

1. It must be large enough to give good exposure to all parts of the bony wound.
2. Its base must be at least as wide as its free margin, to insure adequate blood supply in the healing stage. Vertical incisions must never be so designed that the corner of a flap has an acute angle.
3. It must be made up of the full thickness of the mucoperiosteum, must not be split.
4. Vertical incisions must be placed so as to facilitate healing and gingival reattachment. This is usually in an interproximal area and one tooth distant from the margin of the bony wound, so that a plateau of bone will support the flap margin when it is sutured in position.

Technic of Flap Operation

1. All minimum essentials are checked to be sure they are ready to function.
2. Anesthesia is established.
3. The cheek or lip is drawn aside by the retractor, and the incisions made with the scalpel.
4. The flap is raised with the periosteal elevator. During the course of this step the retractor is made to come to rest on bone, holding the soft tissue aside.
5. The hard tissue surgery is performed—tooth extraction, root removal, cyst curettement, etc.
6. The bony margins are smoothed with rongeurs or bone file.
7. A careful search is made for bone chips, bone dust, particles of tooth substance, amalgam or cement. The policing should be particularly thorough under the edges of the flap and in hidden recesses of the wound. Irrigation and aspiration may be performed.
8. The flap is replaced and sutured. Vertical incisions or lacerations are closed first to make sure that there will be no bare bone.
9. If any packs or drains are inserted this should be clearly entered on the record. No more than a single piece should ever be left in, though it may be of any desired length.

In the remaining operations to be described in this chapter the action is virtually identical for all except for step number 5, the hard tissue surgery phase.

Surgical Removal of Erupted Teeth

It is axiomatic that if a tooth is too solid to be readily delivered by a reasonable try with forceps or elevators, any one of several courses must be adopted.

1. The open beak method may be used.

realistic such an arrangement would be. The general practitioner should be equipped and trained to perform "surgical removal" of teeth if he is to attempt any extractions at all.

Execution of any flap operation comprises an excellent test of an operator's ability. At the University of Minnesota each senior student must take a practical examination in the performance of some type of flap operation prior to graduation. He is carefully observed throughout the entire case by one or more instructors, is scored, and is also asked to grade himself so that it may be determined whether he can realistically evaluate his own operative results. The items used for grading are·

1. Diagnosis and plan; accomplishment thereof.
2. Anesthesia.
3. Time required; wasted motion.
4. Design of flap; incisions.
5. Adequacy of exposure.
6. Instrumentation; scalpel, periosteal elevator, chisel, rasp, rongeur, extraction forceps.
7. Gentleness of handling tissues.
8. Suturing; technic and placement.
9. Neatness of instrument tray during operation and at completion.
10. Aseptic technic.

Each of these points carries a possible score of 10, so that a perfect score would be 100.

There is a greater significance to the flap operation than the fact that it may be used as a test for skill. *It is fundamental to the greater share of operations falling within the field of oral surgery.* This applies not only to all conceivable types of tooth removal procedures but also to the surgical removal of cysts, tumors, and foreign bodies as well as to many of the elective reconstructive procedures. In performing any operation involving the raising of a flap the dentist will find he is using the entire array of commonly used oral surgical instruments. The reason for thorough grounding in the use of them is thus apparent.

Indications for Raising a Flap

There are certain categorical situations that automatically call for the execution of a formal flap procedure:

1. Whenever more adequate exposure of the operative field is required.
2. Whenever removal of bone is necessary.
3. Whenever soft tissue might be injured by the contemplated work on teeth or bone.

One must be realistically aware, however, that with all the benefits of flap procedures, additional surgical trauma is implicit in the method, and swelling, discoloration of skin, and some pain will result in nearly all cases. The patient should be so advised before operation, but the benefits of the procedure should be told also.

fractured root fragment, which has already been described in the section on the use of instruments (p. 75). When the flap has been retracted the simplest attack should be attempted first. Often the forceps can be reapplied with the beaks, at least the one which is applied to the buccal or labial surface of the root, closer to the apex, and extraction can be consummated forthwith, leaving only the simple task of bone smoothing to be done. On other occasions, when the hard tissues are seen stripped of their covering, a tooth division technic will immediately appeal. In still other situations bone should be removed before further application of force, following the plan outlined in the chapter on instruments, with preference being given the bur for mandibular teeth and the mallet and chisel for those in the maxilla.

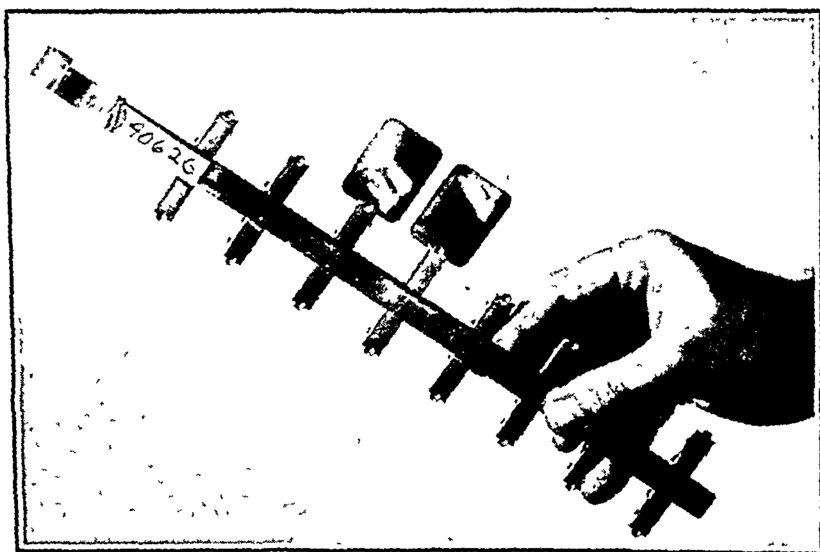


FIG. 94. Postoperative radiograph. Note that *two* exposures have been taken, and identification card marked with wax China pencil, secured to film holder with rubber band.

In any case where tooth removal and bone trimming are in progress, the operator must maintain a proper perspective of the priority of his objectives and do one thing at a time. When removal of a solid tooth is the first objective sufficient bone should be removed unhesitatingly and as promptly as possible before the forceps are applied. When this step is shirked or performed in small increments over a long period of time there is no gain, and the carefully preserved bone will usually have to be removed in the end anyway, either to permit release of the tooth or to smooth the bony margins after extraction is complete.

The thought may be interjected that this is all very well, but what about the prosthetic and crown and bridge considerations of ridge form? It is entirely proper to strive always for the best possible surface contour. Mutilation is never justified. However, removal of the entire tooth, and care of the associated diseased

2. The tooth may be divided up and removed in two or more sections.

3. If these methods fail, or are deemed unsuitable, the flap operation with or without tooth division must be used.

Failure to abandon the simple extraction approach in difficult cases will result either in fracture of the tooth, explosive fracture of the alveolar process with laceration of gum tissue, or uncontrolled

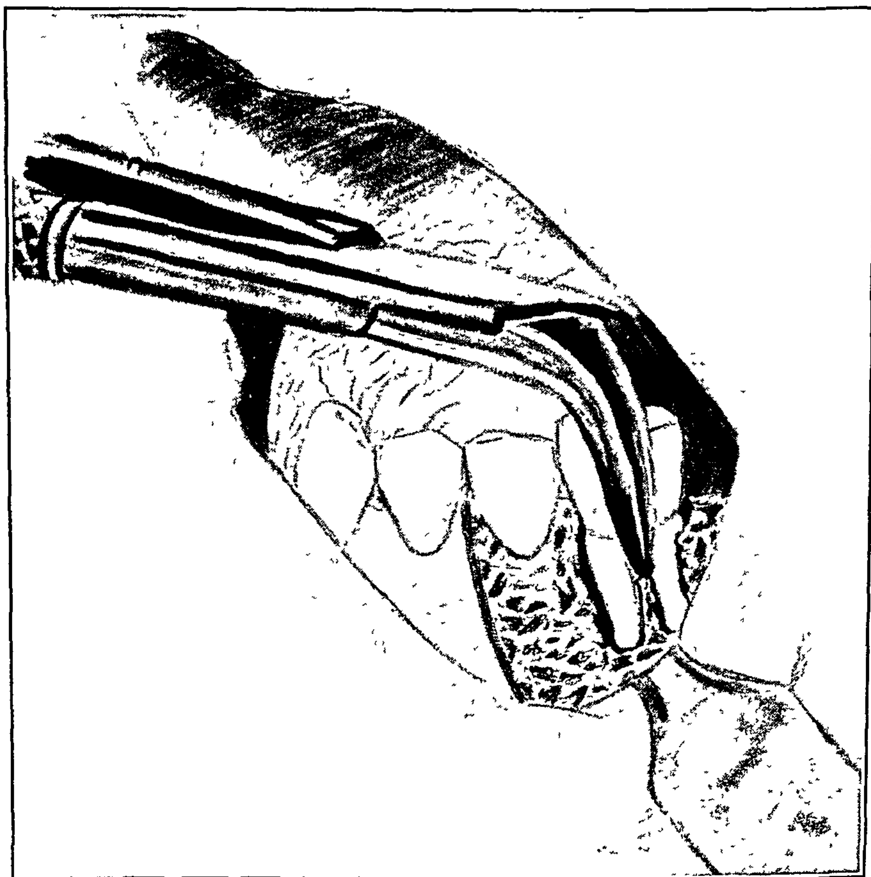


FIG 93 Surgical removal of lower molar

violence with the forceps which may knock out other teeth, tear the lips, or traumatize the temporomandibular joint. Unbridled force must never be used.

These thoughts apply to situations where tooth removal only is the objective of treatment. Frequently it is known in advance that there will be need for smoothing or contouring of the ridge. In such a case the flap may be raised before the extractions are done, giving the advantage of better access, forceps placement, and vision for the actual extractions. The more flaps one performs, the more useful indications he sees for them, and the better will be his results.

It is quite evident that the task of removing a very solid tooth through the flap approach is in reality simpler than recovering a

loss of a root in the antrum, amply justifies this preventive procedure. It is quite evident that whenever a tooth or root is lost in the maxillary sinus, some component of upward force has been applied. This is another of the *faux pas* in the field of oral surgery that constitutes mute evidence of faulty technic.

11. When the root has been recovered three criteria may be used to determine that removal is complete:

(*a*) The tip may be fitted to the previously extracted portion to verify that the missing part has been retrieved.

(*b*) The socket may again be washed, dried, and inspected.

(*c*) Postoperative radiographic examination can be made. In this regard there are several points to be stressed. While not mandatory, routine postoperative radiographs are desirable whenever a tooth has been removed in two or more sections. Two exposures should always be made, as insurance against a blurred or otherwise unsatisfactory picture. An identifying card bearing the patient's number, marked with a wax China marking pencil should be secured to the film holder with a rubber band. The very best radiographic technic should always be used, with the intent that the resulting film shall be properly fixed, washed, dried, mounted, and identified with the date and the patient's name. It may become an important bit of medico-legal evidence. Every student should gain experience in reading wet films revealing known small retained root tips so that he will become familiar with the subtle shadows thrown by these small objects.

Removal of Retained Roots

When root fragments are discovered on routine radiographic examination it is the author's policy to recommend removal and so state in the record. A root fragment can be quite positively identified as such if a root canal and periodontal membrane shadow can be seen. If both of these features are absent, and the shape and position are such that the object is probably an area of condensing osteitis, the patient is so informed and removal is not recommended. If the patient declines to have the root removed, the issue is not pressed but an entry is made in the record to this effect. The vast majority of patients accept the advice and submit to removal.

The removal of a completely buried root tip should be classified as a difficult operation, but is well within the capabilities of a dental student who has learned to use his instruments and auxiliary facilities well. The steps are somewhat different when a landmark tooth appears on the dental radiograph than when the root lies in a totally edentulous area. The procedure is slightly different in the maxilla than in the mandible, mainly in the selection of instruments used to remove the cortical plate of bone.

The steps for an orderly removal of a buried root are as follows:

1. A clear, recent dental radiograph must be at hand, proving the presence of the root, and clearly indicating whether it is on right or left side. If a landmark tooth appears on the same film, permitting

tissue are prerequisites to planning for the future prosthetic replacement. In cases of difficult extraction, the open view flap procedure will always be conducive not only to the best surgical but also to the best prosthetic result.

Removal of Freshly Fractured Roots

There is no stigma attached to the fracturing of roots. Some patients become very apprehensive upon learning that the tooth has "broken off" but the incident need occasion no alarm when methods and instruments are immediately available to complete the operation. The sequence of activity should be as follows:

1. The extracted portion of the tooth should be dried and examined under strong light. The inclination of the angle of root fracture should be noted.
2 The preoperative radiograph should again be studied, with particular attention to direction of root curvature and to nearby structures that must be safeguarded against injury.
3. The operator holds the Gilmore probe in the right hand, using the fountain pen grasp as always with this instrument, while the assistant reaches for the water syringe, which is held in her left hand.
4. The assistant gently aspirates the socket and begins irrigation of the bony recess with intermittent spurts of water.
5. With these aids the operator can often view the retained fragment by direct vision, as the headlight beam automatically falls into the depth of the socket. He will usually be able to discern the root canal as a red dot and the brownish yellow color of dentin will distinguish it from bone.
6. Except in cases of upper posterior roots lying on the floor of the antrum the operator now lightly passes the point of the Gilmore probe into the periodontal membrane space at a point where the root is splintered into its longest side By means of teasing, scraping, and wedging actions many small root tips can be delivered promptly. Heavy elevation should not be attempted with the Gilmore probe.
7. If the probe fails to deliver the root, a slender inclined plane elevator, using in a prying, intruding manner, may succeed.
8 In selected cases, where there is an adjacent empty root socket, a sharp pointed elevator may be used to bite through the septum and engage the retained fragment, thus expelling it. The classical indication for this method is that of a lower molar root, where the other root has been removed.
9. If these measures do not readily succeed, and in all cases of upper posterior root tips lying at the level of the antral floor, a mucoperiosteal flap should be raised without delay and the side of the socket promptly cut away to bring the root into full view.
10. It is recommended that even lingual roots of upper bicuspids and molars be approached in this manner, so that both buccal and occlusal access are available. Though this may seem somewhat radical, it is the only approach which permits the application of downward force on a retained lingual root. The greater danger,

estimation of the antero-posterior position of the root from this landmark, no further pictures need be taken at this time.

2. Local anesthesia is established.

3. If the root lies in an edentulous area, a small suture needle to which a 14-inch length of suture material has been tied is then partially buried in the lingual mucosa in the approximate area of the root. The long end of the suture is allowed to hang out of the mouth. Two dental radiographs are taken (to insure having one good picture) at right angles to the buccal surface of the ridge. When the radiographs have cleared, and the location of the root with relation to the needle is evident, the suture needle is drawn through and tied so that a loop of silk remains at the former site of the needle.

4. An ample buccal mucoperiosteal flap is now reflected, centering on the estimated site of the root and allowing a generous margin for error.

5. (*a*) For mandibular roots a circle of drill holes approximately 1 centimer in diameter is made in the manner described in the section on use of the surgical bur (p. 75). (*b*) For maxillary roots the mallet and chisel are used to remove buccal cortical plate from an area approximately 1 centimeter in diameter.

6. At this point the root may be encountered and readily pried from its bed by the use of a chisel, in the role of a sharp-pointed elevator. If it is not seen, cancellous bone is removed with the hand chisel as the search continues deeper. Frequent use of the water syringe and aspirator will be required in most cases. The use of the chisel to remove cancellous bone is to be preferred over the bur for both maxillary and mandibular roots as the latter may drill away part of the root fragment, making identification difficult.

7. With wide approach, access, and exposure, the root should be recovered in short order. If it is not found promptly in the anticipated location, the landmark needle should be replaced and two more radiographs taken without delay. The radiolucency of the bone excavation will assist in orientation on these new pictures.

8. When removal has been completed, the wound is managed as in the case of freshly fractured roots.

The Removal of Unerupted and Impacted Teeth

The indications for removal of, and philosophy of prophylactic removal of nonfunctioning, embedded teeth have been discussed in the section on selection of patients for surgery. Consequently only the actual technic of removal is all that will be considered in this discussion.

As the various classical types of impacted tooth operations are outlined, certain standard steps common to all will be omitted in the interests of brevity It is to be understood that the establishment of anesthesia, giving of postoperative instructions, and so on, are carried out even though not specifically mentioned.

Lower Third Molars. The rather dramatic subject of impacted lower third molar removal has impelled many writers to develop



Fig 95 Method of localizing retained root fragment with suture needle. *A*, Preoperative radiograph; *B*, radiograph showing location of root with relation to landmark needle; *C*, postoperative radiograph.

elaborate classifications of types of displacements and positions, with special technics and instruments for each. From an academic viewpoint such classification is interesting and may serve to point out the degree of difficulty of removal. However common logic and the experience of removing several of these teeth will soon lead the operator to recognize the variations of position with regard to the ascending ramus, root form, and depth which make for difficulty.

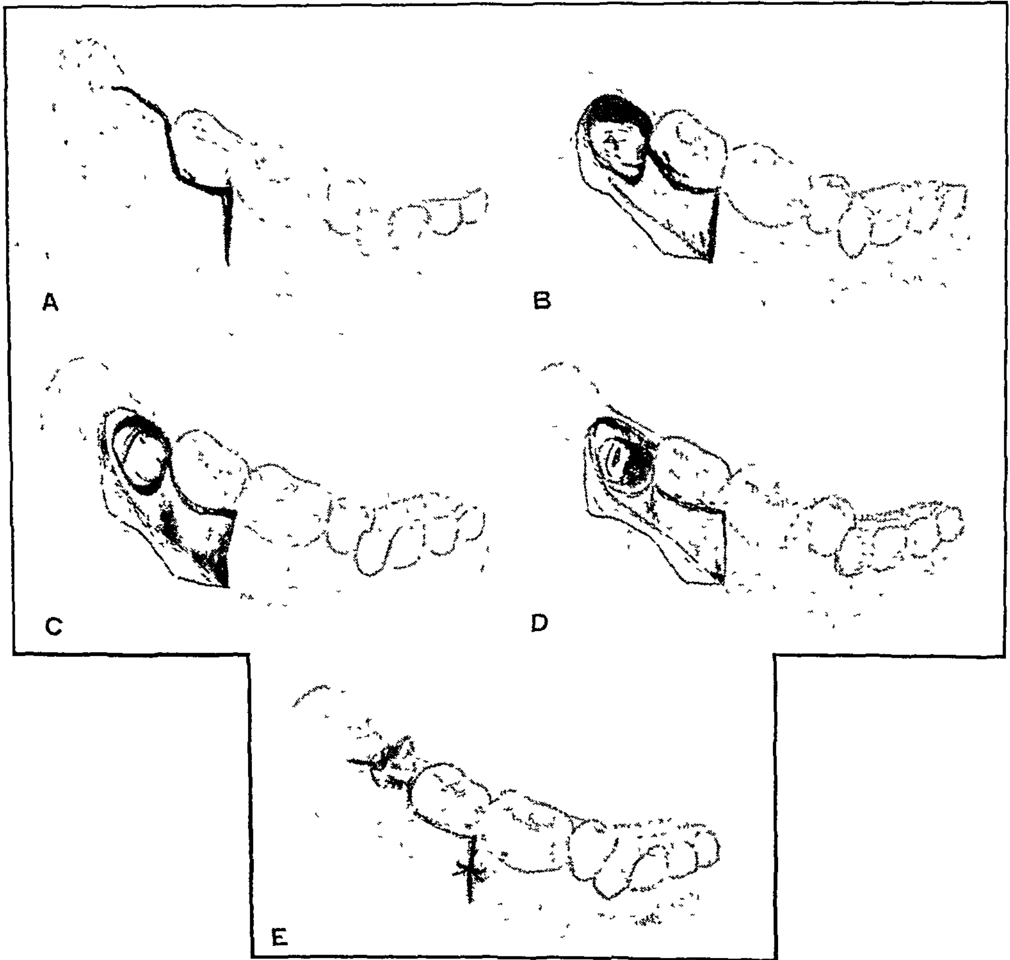


FIG. 97. Removal of horizontal impacted lower third molar *A*, Incision; *B*, flap retracted and tooth exposed; *C*, crown sectioned, *D*, crown removed, *E*, wound sutured and dressing placed

The point that will be emphasized here is the *similarity* of approach to all impacted teeth, for the method of removal is very much the same for all.

In the same vein it is not recommended that occlusal plane or other unusual radiographic views be made unless some exceptional appearance on the routine periapical view indicates the need for further roentgenographic study. This is in keeping with the "standardization of approach" theme, and with adherence to the idea of the Seven Minimum Essentials. The first essential is a clear recent

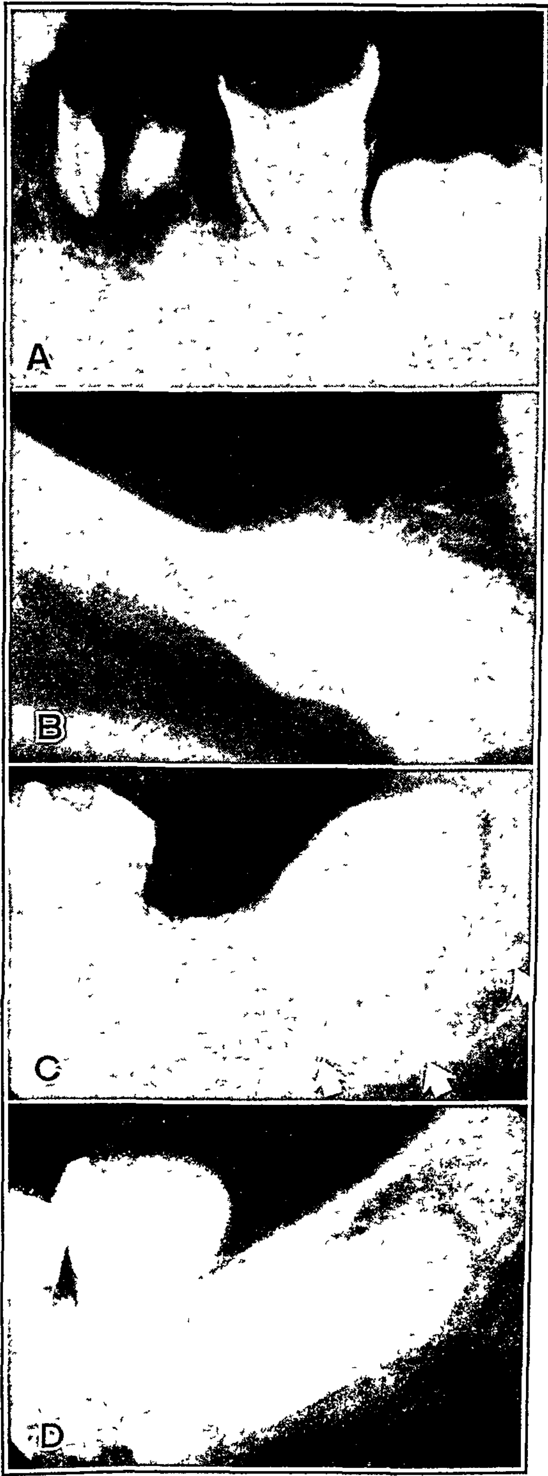


Fig 96. Difficult types of lower molar impactions. *A*, Deep vertical; *B*, malposed and unerupted first molar; *C*, complex roots, *D*, deep horizontal, with ascending ramus far forward

Whenever any doubt exists as to how much force is justified, the operator should elect to use the gentlest method, *viz.* dividing the tooth into sections so that it may be removed piecemeal.

8. As each root is removed with inclined plane or sharp-pointed elevators, the apex should be dried and examined with strong light to determine whether there is any fracture of the apex.

9. If tiny root tips remain they should be removed as delicately as possible due to the proximity of the inferior alveolar nerve and vessels. The Gilmore probe, in conjunction with suction and an intermittent stream of water will yield good results. If the root tip is resistant, the bur may be used with extreme caution, followed by a slender sharp-pointed elevator.

10. The entire wound is inspected and cleared of bone dust, bone spicules, fragments of crown or root, and partially detached portions of the pericoronal sac.

11. Bleeding is controlled.

12. Two postoperative radiographs are made. They may be viewed after thirty seconds in the fixer solution and then placed back to become completely fixed and cleared.

13. The wound is sutured, beginning with the buccal vertical incision. It is more convenient to pass the needle through the anterior margin of the wound first, with the needle holder held upside down, with the ring handles near the ipsilateral eye of the patient. This insures that the suture needle will pass horizontally, which is at right angles to the incision. In passing the needle through the free flap margin the latter is steadied with the retractor or tissue forceps.

14. The socket proper may be sutured shut with or without the insertion of antibiotic medication, or dressed with medicated gauze, at the election of the operator.

15. Instructions for postoperative care, giving of medications, and arrangement for the first postoperative visit complete the operative phase of the case.

Upper Third Molars. Factors More Favorable than Lower Third Molars:

1. The tooth is usually not so malformed.
2. The bone is more porous and hence more easily removed.
3. The anatomy of the part is such that the tooth can be displaced distally—the converse of the situation in the lower jaw.
4. Healing is more rapid due to better blood supply and drainage.

Factors Less Favorable than Lower Third Molars:

1. The tooth is less accessible—more difficult to get at.
2. The maxillary sinus is a close and dangerous neighbor.

Technic of Removal. 1. All Seven Minimum Essentials must be present and functioning.

2. The incisions are similar to those for the lower third molar except that the distal component passes straight back from the second molar, splitting the tuberosity.

radiograph of the entire tooth and some of the surrounding tissues. If this requirement is adequately fulfilled in every case there is little need for additional preoperative radiographic study. The operative technic which will be described is intended to care for incidental variations in tooth position which may be encountered after the tooth is exposed to direct vision.

1. All Seven Minimum Essentials are checked to make certain that they are accounted for and ready to function.

2. The cheek is held back with the retractor and the following incisions made:

(*a*) A vertical incision on the buccal, at the mesial of the second molar,

(*b*) An incision in the gingival crevice of the second molar on buccal and distal, and

(*c*) An incision distally from the second molar, extending up on to the ascending ramus. The location of this incision must be verified by palpation so that it is placed on the crest of the ridge. Placement too far to the lingual invites severance of the lingual artery and nerve.

3. The buccal flap thus outlined is raised. As always, the areas farther down from the neck of the second molar should be peeled up first, to locate the plane of cleavage. The more adherent area, over the third molar crown, should be attacked secondarily, with the aid of direct vision of the binding fibers. Twenty seconds should suffice for the raising of this flap.

4. As the retractor draws the flap buccally and slightly distally, a circle of drill holes is made over the estimated site of the crown. The area thus outlined should be as large as possible without endangering the distal root of the second molar. It is false conservatism to skimp on this step. This trephining method of gaining access to the interior of the mandible is for the purpose of saving time and minimizing trauma. The advantages will be lost if further bone has to be removed by attrition of the margins with the surgical bur.

5. The drill holes are connected and the disc of bone pried out.

6. The tooth is cleaned with light brushing strokes of the revolving bur. This step brings the crown and a portion of the root into good view, and removes undercuts which would interfere with removal. Cancellous bone, the thin overlying cortical bone, and portions of the pericoronal sac are quickly detached in this way.

7. At this point a three-way choice must be made:

(*a*) The tooth may be removed intact with inclined plane elevators. Drilling a traction hole on the side of the root may render this maneuver more effective. The greatest concern at this point is for the welfare of the second molar and prevention of fracture of the mandible by the use of excessive force.

(*b*) The tooth may be split with the mallet and chisel.

(*c*) The tooth may be divided up into several sections by the use of the bur and elevators.

additional view of the lateral incisor region should be obtained. When the mounted radiographs are carefully scrutinized, any one of three possibilities will be found to exist:

1. If the unerupted tooth appears to move farther distally (with relation to a fixed landmark such as the root of the central incisor) as the x-ray tube is moved farther distally, then the unerupted tooth lies to the lingual of the landmark tooth; *i.e.* "the tooth follows the tube."



FIG. 98. Radiographic localization of impacted upper cuspid As the tube is moved *distally* the cuspid moves *distally* with relation to the landmark tooth (central incisor) The cuspid lies on the lingual.

2. If the unerupted tooth moves mesially as the tube moves distally, then the unerupted tooth lies to the labial of the landmark tooth.

3. If the unerupted tooth remains stationary, it lies at the same depth as the landmark tooth.

In either of the last two cases the proper surgical approach is from the labial, and the operation is essentially the same as that for recovery of buried root fragments. In the first instance the approach must be from the palatal side. The operation is performed as follows:

1. A large palatal flap is raised, devoid of vertical incisions. The lingual gingival attachments are incised from the region of the first molar of the side to be operated upon around to the first bicuspid region of the opposite side. This seemingly radical approach is actually less mutilating than that resulting from a small tongue-shaped flap. The latter often leaves a funnel-shaped defect in the palate, since there is inadequate bony support for the flap margins.

3. The buccal, occlusal, and distal aspects of the crown are uncovered by the use of the chisel as a hand instrument or with the mallet and chisel. The order of bone removal is from behind forward, so that the greatest margin of safety will be maintained for the distobuccal root of the second molar.

4. When sufficient overlying bone has been removed the inclined plane elevator is inserted on the mesial, at the neck of the tooth, with an intruding, wedging, slightly levering action. The tooth is removed in a *downward, outward,* and *backward* direction.

5. No inadvertent *upward* vector of force must be allowed to occur, either intentionally or unintentionally, for the tooth may be displaced into the maxillary sinus. It is for this reason that the use of extraction forceps is not advised.

6. Tooth sectioning of upper third molars is a difficult procedure and fortunately is seldom required. If the tooth is extremely solid and resists removal by the standard approach, the "broken instrument technic" as used for unerupted lower bicuspids, may work to good advantage.

7. If tiny root tips remain:

(*a*) They should be removed by the method previously described for all freshly fractured roots.

(*b*) If the operation for removal is beyond the capabilities of the operator, the patient may be referred to a qualified oral surgeon.

(*c*) They may be left *in situ*, and the patient advised of the fact. Needless to say, this is not a highly recommended alternative, but is better than doggedly continuing the operation until the antrum is opened and possibly the roots lost therein.

8. Sutures are placed on the buccal and distal aspects of the wound No drain is used.

Upper Cuspids. The removal of an impacted upper cuspid by the palatal approach, in a situation where the adjacent teeth are to be retained, probably constitutes the most difficult task in the entire gamut of tooth removal operations. It should be undertaken only by well-trained and thoroughly experienced operators.

While the reasons for advising removal of impacted upper cuspids are the same as for other unerupted teeth, it is desirable to have orthodontic consultation whenever there is the remotest possibility that the tooth might assume its place in the arch with or without formal orthodontic treatment. In some cases the crown should be completely exposed to give the tooth every opportunity to erupt If this course is chosen the operation simply consists in complete removal of all soft and hard tissue lying between the crown and its future position in the dental arch.

Radiographic Localization. Although over three-fourths of all impacted upper cuspids lie to the lingual of the other teeth in the arch, it is necessary for the operator to know with certainty which situation pertains so that he may select the proper surgical approach.

The standard periapical radiographs of the area are studied very carefully. If the cuspid does not appear on at least two films, an

root fracture at the level of the drill hole no harm is done, and one fragment or the other will usually be loosened so that removal of that portion is readily accomplished. The process can then be repeated on the remaining segment if it cannot then be removed with small elevators.

Supernumerary Teeth. The technic for removal of supernumerary teeth does not differ in any major respect from that for removal of impacted teeth of the regular dentition.

The commonest of these anomalies is the mesiodens, which is managed much as a miniature impacted upper cuspid. They often occur in pairs, and, when lying to the lingual of the normally formed teeth should be approached with the large palatal flap, which will give ample access for removal of both.

Supernumerary bicuspids are removed in exactly the same manner as impacted bicuspids of the regular dentition.

Ridge Trimming Procedures

Alveolectomy. This term literally means the removal of all or part of the alveolar process, and probably should include all procedures where any alveolar bone at all is removed. However, by tradition and custom it has come to mean the deliberate shaping or contouring of the alveolar process after teeth have been removed. A reference to the instructions for use of the rongeur forceps and side cutting bone forceps will give the bulk of the technical considerations that are needed to do good alveolectomies either immediately after removal of the teeth or at some later date.

When the operator has become thoroughly familiar with his instruments and oral surgical aids, this task becomes thoroughly enjoyable, and there remain only the questions of how promptly and how nicely it can be done. The operator can give close attention to the business of sculpturing the living tissue upon which he is working. The prime requisites are removal of sharp points, undercuts, and excessive vertical heights that would be undesirable from the standpoint of denture construction. The ridge should emerge rounded, with a convex contour on the buccal aspect. This is difficult to accomplish when the roots of the recently departed teeth were very close together, or the bone very brittle or frail. Severe periodontoclasia or some other disease process may have so altered the bony ridge that it is impossible to produce the desired full-rounded contour. In such cases the ultimate of salvage of ridge form may be achieved by deferring ridge trimming until several weeks have elapsed after simple extraction of the teeth. In this way the maximum amount of bony tissue may be preserved and the alveolectomy reduced to nothing but the shaving off of such bony spurs and spines as may be present.

An ever present consideration in alveolectomy procedures is the preservation of the buccal sulcus. The mucoperiosteal flap must be peeled back far enough to give good access for the bone cutting

2. The large flap thus outlined is raised by working from each side toward the midline. In this way the stalk of tissue containing the nasopalatine nerve and terminal portion of the sphenopalatine artery can be drawn from its canal, clamped, and cut close to the flap. This permits easy tying off if necessary. If the vessels are cut close to the bone they may retract into the canal where they would be difficult to reach for ligation, should that prove necessary.

3. A traction suture is inserted and the flap drawn down and toward the opposite side. Frequently only a thin scale-like layer of bone overlies the pericoronal sac and crown of the cuspid. This may be readily shaved away with the hand chisel, thus giving a fair view of the crown and permitting an estimate of the precise position of the tooth in the jaw.

4. If the tooth is not visible a disc of bone should be removed by the circle of drill holes technic.

5. While it is occasionally possible to elevate the tooth intact at this point with an inclined plane instrument, it will usually be wiser to cut off the crown along with a portion of the root, by means of the bur and elevators, as described in the method for tooth sectioning.

6. As some of the bulk of the tooth comes away the remaining portion becomes more vulnerable to attack with small inclined plane elevators, or judicious use of the bur plus sharp pointed elevators. These teeth commonly have a sharp curvature at the apex, so that repeated sectioning may be required, until finally the curved apex may be teased out along a curved path.

7. The entire wound and socket are cleared of débris and the flap replaced. Firm pressure should be maintained by the patient's thumb through a pad of gauze for five to ten minutes. Atmospheric pressure and the intermittent upward force of the tongue in swallowing keep the flap in place without sutures.

Upper and Lower Bicuspids. The general plan of removal is similar to that for removal of retained roots. Great care must be exercised to avoid injury to the adjacent teeth. The buccal approach is to be preferred whenever possible. However, when the embedded tooth is readily accessible from the lingual, as evidenced by a slight bulge beneath the mucosa, the lingual access should be used.

The byword in removing any embedded tooth from amongst the roots of others which are to be retained is to "cut up the tooth you are going to throw away." Piecemeal removal appears unsystematic, but in reality is the wisest course to follow when all basic considerations are taken into account.

The Broken Instrument Technic. A useful aid in mobilizing embedded teeth or roots, where the access must be kept small in deference to the adjoining teeth, is the drilling of a bur hole straight into the center, then inserting the shank of a broken dental instrument having the same diameter. By levering or rotating with the instrument an effective bodily movement can be achieved and the tooth often removed like a sausage impaled on a stick. Should the

Three courses of action are possible: 1. Simple extraction of the teeth and insertion of the denture. This would apply if the teeth are removed by simple extraction, and no carving was done on the model.

2. Attempted simple extraction, with the raising of a flap if necessary to complete removal of very solid teeth, or to reduce the bulk

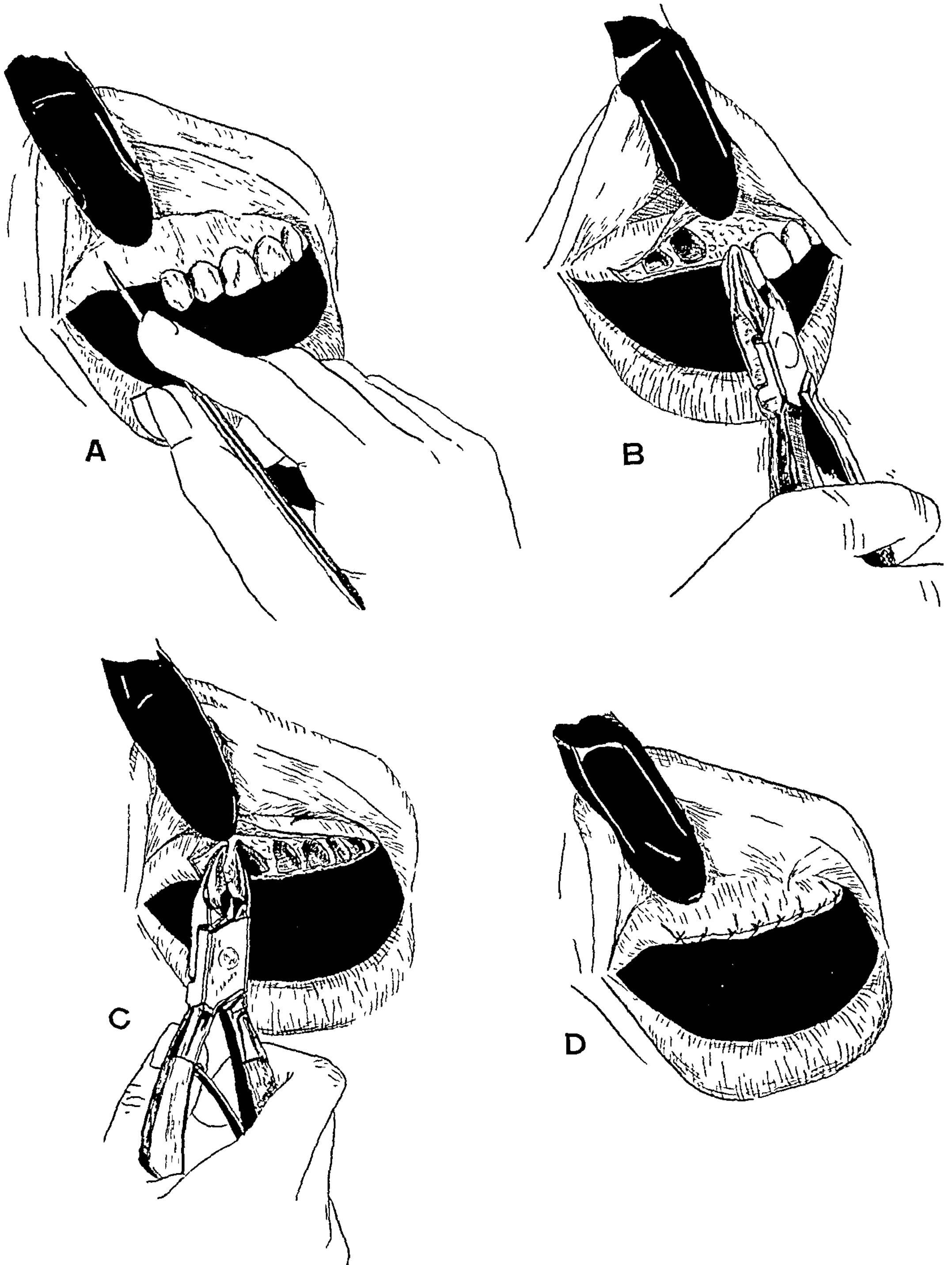


Fig 99 Plan for removal of upper anterior teeth with alveolectomy. (Same steps used for immediate upper denture) *A*, Incision; *B*, extraction; *C*, bone trimming; *D*, suture

instruments, yet if reflection is excessive there will be a resulting loss of ridge height.

Experience will bring the realization that it is not well to strip up the lingual mucoperiosteum more than a very small amount. Rather, the major amount of attention should be devoted to the buccal and occlusal aspects of the ridge. Stripping up the tissues on the lingual as well as on the buccal seriously compromises the blood supply to the bony ridge, inviting necrosis. Furthermore, an excessively large dead space is left which may lead to the development of an unjustifiably large hematoma.

When the hard tissue phase of the alveolectomy has been completed with rongeur and rasp, and adjudged satisfactory after careful palpation with the finger tip, all débris is meticulously cleared away by the use of the double ended curet and suction aspirator. The soft tissues are then allowed to fall into place and consideration is given to the need for trimming of their margins. It is far better to err on the side of leaving too much mucoperiosteum, for, as the saying goes, it can always be removed later, but once gone cannot be replaced. The things to be avoided are bare bone and too drastic a reduction of the buccal sulcus. It is generally customary to trim off the interdental papillæ so as to render the wound margins somewhat straighter and to eliminate the hypertrophied granulation tissue attached to them that has been formed by periodontal disease. However, equally good arguments can be advanced for leaving the papillæ in place, to wit that the granulation tissue will reduce in size and revert to scar, and that this marginal gingival tissue is thick and tough—ideal covering for the crest of the ridge where it will serve well to bear the load of the future denture. The issue is one which must be solved by the best judgment of the operator in each individual case.

Immediate Denture Insertion. There is much to commend this technic in the case of upper dentures, but considerably less for lowers. The advantages which are commonly stated are that the patient will not have to go without anterior teeth, an advantage from the viewpoints of esthetics and function, and that the denture will serve as a protective splint to protect the surgical wound. These arguments carry more significance in the case of upper dentures than lowers.

The essence of the plan is that the denture is made up beforehand while the teeth, usually just the six anteriors, are still in place. The model is rendered edentulous and in addition a certain amount of carving done to simulate the removal of unwanted bone. The operation consists of then fitting the patient's jaw and tissues to the previously constructed denture. The amount of alveolar surgery to be performed will depend upon the amount of carving that was done on the model along with the "extraction" of the plaster teeth, as well as on incidental bone removal that may be required to extricate the teeth from their sockets and to eliminate disease processes that may be present.

REMOVAL OF SOFT TISSUE LESIONS WITHIN BONE

1. As the flap outline is being planned it is wise to consider whether the wound is to be closed completely, with the intention of securing primary healing, or whether it is to be left open, subjected to repeated gauze dressings, and allowed to fill in by granulation. In the first instance, the flap is the same as for surgical extractions. In the second case, it is customary to make the operative wound the same size as the window which will be left open during the postoperative phase.

2. After the flap has been reflected the overlying bone is removed to a sufficient extent to permit adequate access to the interior. In the order of preference the instruments used for this step are: the rongeur forceps or side cutting bone forceps, hand chisel, mallet and chisel, and surgical bur.

3. The lesion is now examined and evaluated as to the following features:

(*a*) Presence of fibrous capsule and its quality as to toughness or friability, (*b*) presence of fluid within the lesion, and (*c*) possibility of malignancy of the lesion.

4. Assuming that the preoperative diagnosis has been that of a cyst or benign tumor, complete removal is accomplished at this point. Any or all of the following instrument technics will be found effective:

(*a*) Separation of the capsule from the bony wall with the double ended curet or the broad end of the number 7 wax spatula, (*b*) pushing the capsule away from the bony wall with a gauze sponge held by a hemostat or the nasal dressing forceps, or (*c*) grasping the membrane with the blunt nosed rongeur forceps or a hemostat and pulling it away from the bony wall. This method renders the portion of the lesion so handled unsuitable for microscopic examination but may be used if adequate material has already been obtained for study.

5. In the process of removal, care must be taken not to traumatize unnecessarily the inferior alveolar or mental nerve and vessels, the lining of the maxillary sinus, or the lining of the nasal cavity. Cysts and benign tumors virtually always push the major vessels and nerves aside rather than envelop them, so that careful technic should make it possible to separate these structures from the fibrous sac of the lesion. Inadvertent opening into the antral or nasal cavity is likewise preventable. The area where the lesion contacts the body space should be carefully tested for bony competency before curettement is undertaken. If it is evident that no bony partition remains, an attempt may be made to split the tissues of the lesion away from the epithelial membrane of the body space, or better yet the sac of the cyst, if such it be, may be left *in situ* so that the intended operation for removal becomes a marsupialization procedure.

When complete removal of the lesion is mandatory, as in the case of a proven giant cell tumor or ameloblastoma, a somewhat more

of alveolar process if the denture does not fit on preliminary trial.

3. The raising of a flap at the beginning of the operation, then:

(*a*) Performing extractions, trimming, and suturing, or

(*b*) Removing bone prior to application of forceps, as when the teeth are very solid, then extracting, trimming, and suturing.

If it is likely that a flap will have to be raised sometime during the operation it should be done at once. This permits better vision and access, higher grasp with the extraction forceps, and a more smoothly integrated procedure.

In other words, only if the cast has not been carved, and if radiographs show that extractions are going to be simple, only then should one extract without first raising a flap.

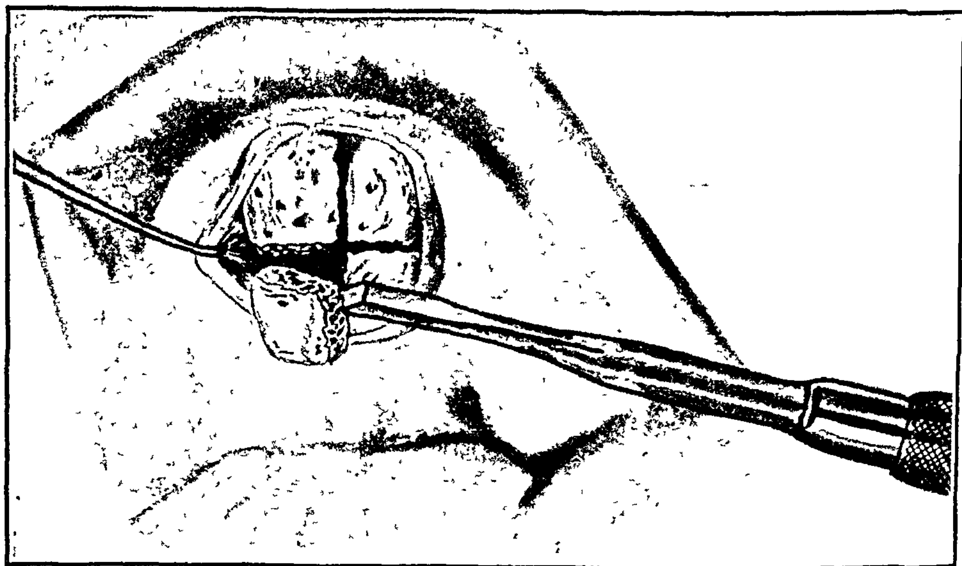


Fig 100 Removal of torus palatinus

Removal of Surface Bony Growths

From the standpoint of pure surgical technic there is no essential difference in the operations for removal of exostoses, tori, ossifying fibromata, or the proliferating lesions of Paget's disease.

In each of these conditions the lesion is benign and the surgical removal is performed simply to eliminate the annoyance occasioned by the bulk of the mass, or to render the surface amenable to the reception of dental prosthesis Complete eradication of the disease process is not intended nor is it necessary.

Instructions for performing the standard flap operation should be followed. The action in step 5 consists in either of two alternatives:

1. Removal in one piece with mallet and chisel, or
2. Piecemeal removal by making transverse grooves with the bur, then prying off fragments and finally smoothing the base.

radical view must be taken and all portions of the tumor meticulously removed. When the operator has convinced himself that no neoplastic tissue has been left behind he must manage the resulting anatomical defect in the best manner possible, but a fistula into the nose or antrum should be avoided if at all possible.

6. After gross removal of the lesion has been completed, hemorrhage is controlled. If pressure with a gauze pack does not effectively arrest the bleeding, gelatine sponge soaked with bovine thrombin may be applied.

7. Cauterization with phenol and alcohol, silver nitrate, the fulgurating electrode of the short wave diathermy machine, or with actual cautery may be done if desired. This is usually omitted in the case of cysts, occasionally performed with giant cell tumors, and always done in the case of ameloblastomas.

8. The bony defect is either loosely filled with iodoform gauze strip which has been impregnated with acrithesin ointment, filled with bats of gelatine sponge saturated with penicillin solution, or allowed to fill with blood clot. Each of these methods of management has its advantages and disadvantages, which must be weighed in each individual case.

9. The wound is closed with sutures or dressed open, depending on which of the previously mentioned alternatives has been selected.

The Partsch or Marsupialization Operation. As originally described by the man whose name it bears, this operation consisted of not only cutting a window into the wall of a cyst, but also rolling a flap of the overlying epithelium into the cavity and suturing it in place so that a portion of the rim of the opening would be covered by epithelium. As commonly performed now, the procedure consists essentially of removing a disc, one or more centimeters in diameter, of the cyst wall and all tissues covering it, so that the cyst is thereafter permanently decompressed. It has been found that cysts managed in this way will steadily decrease in size and often become completely obliterated. The more extensive enucleation operation may thus be avoided and, what is more important, injury to vital structures may be obviated. A *sina qua non* of the procedure is that the opening must be maintained, and to this end the patient must be kept under observation to be sure that scar contracture does not close the orifice. An intrinsic disadvantage of the method is that the entire cyst membrane is not available for pathological examination, so that a possible ameloblastoma may be overlooked until considerable time has passed. The entrance of food particles into the cavity gives little cause for concern, as the patient may care for this by irrigation with a small ear and ulcer syringe each night before retiring. A successful Partsch operation ends with nothing but a small depression to indicate the former location of the cyst.

Removal of Hard Tissue Lesions within Bone

The operative procedure is essentially the same whether the lesion is a compound odontome, complex odontome, anomaly of the tooth

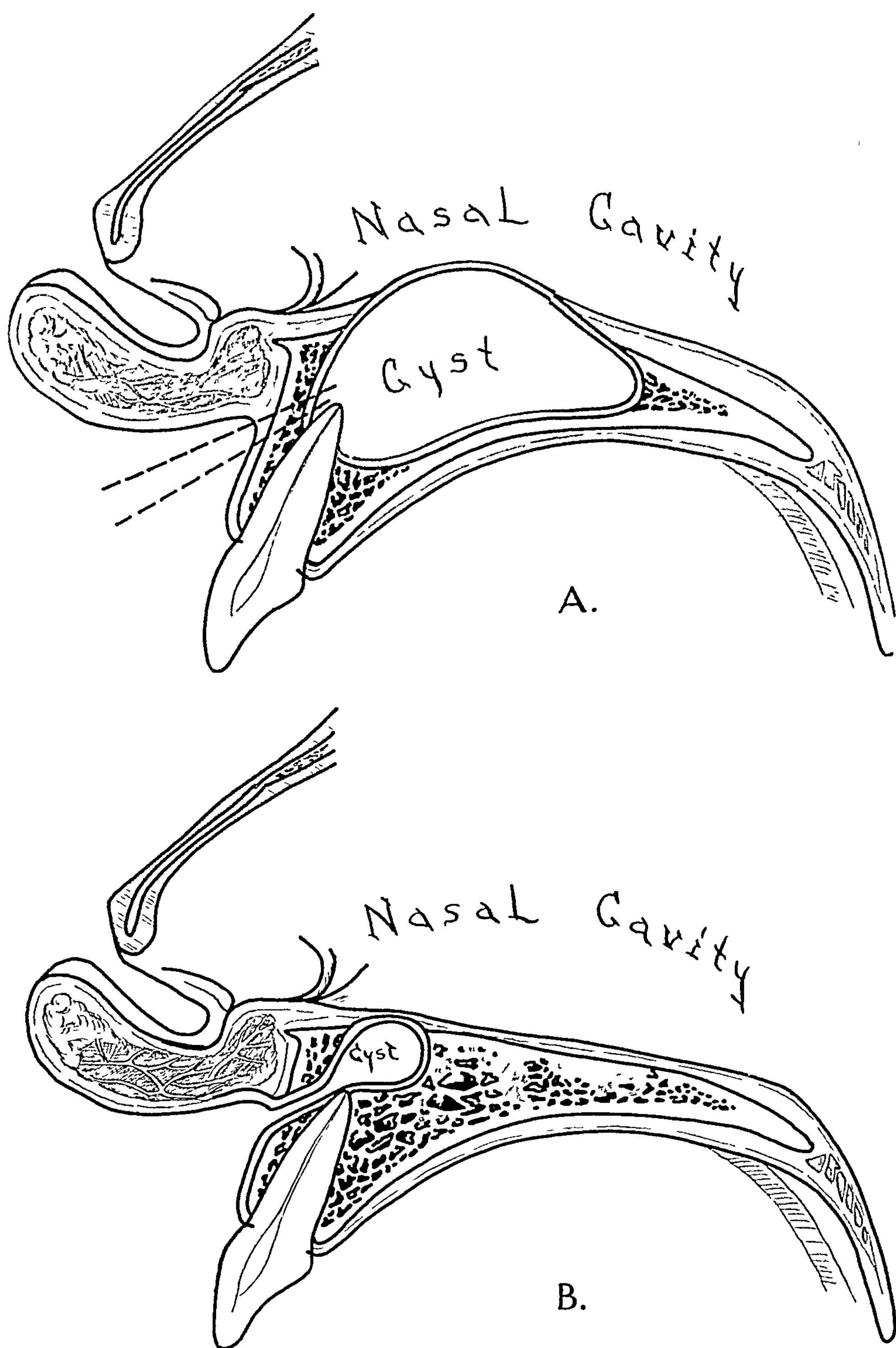


FIG 101. Plan of Partsch operation *A*, Site for construction of window, *B*, cyst reduced in size after prolonged exteriorization

8

Postoperative Care and Complications

EVERY dentist who accepts patients for oral surgical treatment must understand that he has a moral and legal responsibility to render all necessary postoperative care that may be required, or to delegate someone else to do so in his place if he is to be out of reach. The latter arrangement must be agreeable to the patient and the substitute and known to both of them. If the dentist is unwilling or unable to be available for care on weekends or during the night he should refrain from accepting oral surgical cases.

The remarks in this chapter will be concerned mainly with the situations occurring during or shortly after the routine removal of teeth, since these cases outnumber all other forms of oral surgery in general practice by a wide margin. The postoperative care and complications associated with fractures, mandibular resections, and so forth are discussed in the appropriate section.

Many postoperative sequellæ are not complications in the true sense, but rather the expected after effects of surgical trauma. Anyone who has unintentionally struck his own thumb with a hammer knows the excruciating pain that follows the forceful impact of steel on tissues! There is a tendency to forget that while local anesthesia gives blissful freedom from the *pain* of trauma while the operation is in progress, it gives no protection for the immediate postoperative period. Salicylates are very helpful in allaying this type of discomfort, but to be most effective they should be administered at the time the local anesthetic is given.

In addition to pain, *swelling* and *stiffness* follow surgical trauma as a matter of course. All of these effects are roughly in direct proportion to the severity and length of the operation. As the dentist gains in experience, he can anticipate that the magnitude of these sequellæ will decrease. It must be remembered that swelling and stiffness are normal components of the inflammatory process, without which healing could not occur. It is only when they are excessive that they assume the proportions of a complication.

In evaluating postoperative swelling the dentist must attempt to determine whether he is dealing with edema, hematoma, or cellulitis. Each calls for somewhat different management. Stiffness may be simply the manifestation of edema of the masticatory muscles or on the other hand may be due to injury of the temporomandibular joint or due to a hematoma or abscess in the internal pterygoid or masseter muscle.

forming organ, condensing osteitis, ossifying fibroma, cementoma, or intra-osseous lesion of Paget's disease.

These operations are among the most difficult and unsatisfying which the operator will be called upon to perform. When the radiograph reveals an indistinct outline of the radiopaque mass and no evidence of a fibrous capsule, it may be concluded at the outset that the lesion will require piecemeal removal with bone cutting instruments, and that some normal bone will have to be removed all around the mass, if the resulting postoperative radiograph is to give evidence of complete removal.

Faced with this uninviting prospect, the oral surgeon will often properly decide that removal should not be advised for any except masses which are impeding eruption of a tooth or have become infected. Those with a well-formed capsule are most favorable for removal.

The operative approach for excision of these calcified objects is by means of the usual flap, then exposure of the object with the chisel or bur, and finally removal *in toto* or piecemeal in the same manner as that used for impacted teeth.

The resulting bony defect will usually fail to heal by first intention and is best handled by the institution of gauze dressings from the outset.

The removal of foreign bodies, such as shell fragments or other particles of metal which have become lodged within bone follows the same general lines as that used for removal of pathological lesions. In some respects it is easier, for the metal will separate readily when undercuts have been removed. A word of caution should be given on the possibility of the object's having weakened the wall of a large vessel as it passed through the tissues; sudden severe hemorrhage may occur when it is moved from its position. Adequate facilities must be on hand to control the bleeding by ligation or packing.

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4. If these measures do not succeed, phone or come to this clinic. Holidays, nights, and weekends get in touch with the dentist on call at the University Hospital. telephone FIlmore 7311.

5. It also helps to stop bleeding if you will lie down, with the head raised on several pillows. Apply an ice bag or cold compress to the cheek on that side Do not become alarmed or excited. The average patient can lose a pint of blood without ill effects. Do not take tea, coffee, or other stimulants.

Explanation of Symptoms that May Occur:

1. Swelling of some extent follows nearly every tooth extraction. This is Nature's way of beginning the healing process. It does not mean infection has set in providing there is no fever, pain, etc. After the removal of impacted teeth or trimming of the bone, swelling is often quite severe It is most marked on the 2nd or 3rd day, and begins to disappear on the 4th day.

2. Stiffness of the jaws is also Nature's way of splinting and resting the part which needs to be repaired, and usually relaxes about the 4th or 6th day.

3 Black and blue marks on the face are caused by bleeding internally into the cheeks or chin. This appears first as a swelling, but after the 2nd or 3rd day it may discolor the face yellow, black, or blue. It will gradually disappear in a week or ten days. A hot wet towel, wrung out very dry, may be applied for ten minutes, 3 times a day. This will be comforting but will not greatly speed up the fading process.

For the relief of *pain* due to trauma two 5-grain tablets of acetylsalicylic acid are dispensed to all patients in a small envelope. Jars of 1000 such tablets in white, pink, or yellow may be purchased at nominal cost. The dispensing envelope carries the following information:

This envelope contains tablets to be taken for pain. If more tablets are required, ordinary 5-grain aspirin tablets may be used in the same manner.

Dosage:

Adults—Two tablets every 4 hours.
Children aged 5 to 12—One tablet every 4 hours.
Children under 5—Half a tablet every 4 hours.
If severe pain persists, call this clinic.

A similar small envelope, of different color, containing two $\frac{3}{4}$-grain capsules of pentobarbital sodium, is dispensed to patients who have had somewhat more than the usual amount of trauma, and who might therefore have difficulty *sleeping* even though pain were relieved. The information on this envelope is as follows:

This envelope contains capsules to produce sleep. Take at bedtime, with a glass of warm milk.

Dosage.

Adults—One or two capsules
Children aged 8 to 12—One capsule.
Children under age 8—Half a capsule.

Caution! Do not drive a car or travel about unattended for at least eight hours after taking.

Good postoperative care can do much to minimize the more or less normal effects resulting from purposeful surgical trauma. The conscientious dentist will attempt to give detailed instructions for home care. The giving of verbal instructions consumes valuable time, and the suggestions are often poorly understood and quickly forgotten. Patients are prone to call back on the telephone to verify some point, which takes up more of the dentist's time. From a medico-legal standpoint it would be difficult for a dentist to *prove* that a certain instruction had been given, if the information was conveyed verbally.

The printed leaflet obviates these difficulties and makes it possible for all patients without exception to have authentic information in simple language at the time when they need it most. The contents of the leaflet which is used at the oral surgery clinic of the School of Dentistry, University of Minnesota, are as follows:

CARE OF THE MOUTH FOLLOWING EXTRACTIONS

General Instructions.

1 Unless otherwise directed, do not rinse the mouth the day of surgery.

2 Beginning the next day, rinse the mouth vigorously, using up a full glass of hot water, in which a half teaspoonful of salt and a half teaspoonful of soda have been dissolved. Continue this every hour on the hour. If you cannot get a supply of salt and soda, *use the hot water anyway.*

3. Keep taking nourishment Try not to skip a single meal. Begin by eating liquid or soft things such as heavy soup, milk toast, soft boiled eggs, milk and cream, or well-cooked cereal. As soon as possible get on to solid food. You will feel better, have more strength, less pain, and heal faster, if you continue to eat. Drink at least 8 glasses of liquids daily.

4 You may notice that some small stitches have been placed in the gums. These are to be removed by the dentist on about the 4th, 5th, or 6th day after the operation.

5. If you have severe pain, fever, or bodily illness, get in touch with this clinic at once. Weekends or holidays contact the dentist on call at the University Hospital telephone FIlmore 7311.

In Case of Bleeding:

1. After your teeth were removed, a gauze or cotton compress was placed on the wound and you were asked to keep your jaws closed tightly for fifteen to twenty minutes. This was to help stop bleeding and keep saliva away from the open tooth socket. This compress may be discarded after fifteen or twenty minutes.

2. Should slight bleeding continue, it is a good plan to put a fresh, clean wad of cotton on the bleeding place in the same manner, large enough so that it makes pressure when the jaws are closed tightly Hold it thus for twenty minutes by the clock This may have to be repeated 3 or 4 times

3. If the bleeding continues in spite of the above, make a small amount of strong tea, boiling it for five minutes, then soak a small ball of cotton in the tea, and place firmly in the tooth socket which is bleeding. On top of this place a large hard ball of cotton and close the jaws tightly to make pressure. Hold this way for twenty minutes by the clock If you do not have the tea, use powdered alum made from a bit of crushed styptic pencil.

lower third molar removed. The fracture patients pay very little attention to the numb lip, and may not even mention it unless the examiner questions them on this point. On the other hand, the patient with anesthesia of the lip following an elective operation tends to make a great deal of the matter, and may even bring a lawsuit against the dentist. Preoperative warning about this and all other possible adverse developments helps patients to accept them philosophically. In all instances of injury to the inferior alveolar nerve there is a strong tendency for sensation to return in a matter of weeks or months. Regeneration of the mental nerve is considerably less certain.

Interestingly enough, anesthesia of the anterior part of the hard palate following severance of the nasopalatine nerve during removal of impacted cuspids is scarcely ever noticed or complained of by the patient.

Careless handling of instruments may result in injury to structures other than those within the operative field. Incredible as it may seem, lawsuits are on record for such complaints as loss of an eye due to injury by a suture needle during the course of sewing up a laceration of the lip! Such palpable examples of gross carelessness should never occur if the operator simply resolves always to work carefully.

The best course to follow in any instance of accidental injury to soft tissues is to first repair the damage, which will usually be by suturing, second, calmly inform the patient about the situation without giving undue cause for alarm, and third, consider the possible need for consultation or referral to some other professional colleague. If the accident is sufficiently serious, the dentist should advise his liability insurance company of the incident so that counsel may be given on the best method of handling the legal aspects of the situation. This advice applies to all other accident situations in the dental office as well.

B. *Hard Tissues.* (*a*) *Teeth.—Extraction of the wrong tooth* is responsible for more lawsuits against the dental profession than all other causes combined. Fulfillment of the first Minimum Essential will go far toward preventing this mishap. If the dentist senses something a little queer as he is comparing the radiograph, written record, and appearance of the tooth in the mouth, he should *stop* and carefully review the situation before extracting. This "triple check" should always be performed for all cases of single or scattered extractions. It need hardly be emphasized that the dentist and patient must be in agreement on which tooth is to come out. A good general rule is to be sure that the tooth about to be removed is a "bad" tooth.

Thoma advocates sterilization and filling of the root canal, replantation, and splinting as a possible expedient for cases where the wrong tooth is removed.[1]

Loosening of adjacent teeth, or injury to their cementum or supporting bone by the injudicious use of elevators, forceps, or burs is

It has been found that patients will put up with almost any complication with very little complaint if it has been described to them before it occurs. On the other hand they are prone to be critical of the dentist when some unpleasant surprise comes to them without warning. Upon returning for postoperative observation and treatment they will frequently say, "Oh, yes, there was lots of swelling and some pain, but that was described in your instructions so I rather expected it." A favorable attitude toward the dentist helps both patient and operator, and this is the usual consequence of properly educating the patient about unpleasant effects before they happen.

LOCAL COMPLICATIONS

Accidents

Accidents might be classified as avoidable and unavoidable, but there would be much overlapping and it is better for the open-minded dentist to consider all accidents as avoidable, and to assiduously devote himself to keeping them at an absolute minimum. Faithful adherence to the Seven Minimum Essentials will do much to avoid accidents.

UNINTENDED INJURY BY SURGICAL INSTRUMENTS

A *Soft Tissues.* Careful operating technic with good retraction, hemostasis, and illumination will do much to prevent mutilation of the gingiva, cheek, lip, or tongue. Soft tissues should be under tension whenever sharp instruments are being used upon them so that the action will be under good control. Partial avulsion of the soft tissues around a tooth can be avoided by keeping all adjacent structures visible during application and use of the extraction forceps. Sharp-pointed elevators should be used with well-controlled force, as they can cause severe lacerations if they slip while being applied in an unbridled manner. Whenever a carborundum disc is being used to cut a bridge, the cheek, lips, and tongue must be shielded by tongue depressors or the dental mirror. If the engine belt is loosened before this procedure is done, the disc is not likely to jump if it should jam

Injury to the inferior alveolar or mental nerve may occur in spite of the very best surgical technic. Surprising as it may sound, the best way to avoid injury to nerves or vessels is to have them out in plain view, as injury is not likely to occur when they can be seen and protected. The possibility of bruising or severing these structures should always be mentioned to the patient before operation, when they lie in close proximity to the operative field. Theoretically this gives the patient the right to refuse the operation; actually such a change in plans seldom occurs.

It is interesting and somewhat amusing to observe the difference in attitude regarding numbness of the lip between patients with fracture of the mandible and those who have had an impacted

the patient, chemotherapy, and vigilant follow-up should be unfailingly executed.

There is one special situation regarding the antrum that must be kept in mind every time an upper posterior tooth is extracted. When it is present the dentist must make the diagnosis immediately and call the condition to the attention of the patient without delay. If, immediately after the extraction, there is a profuse flow of purulent or mucopurulent fluid, the presence of empyema of the maxillary sinus should be suspected. The sinusitis may be of either nasal or dental origin. An antra-oral fistula is certain to follow the extraction and the dentist will surely be blamed for causing it unless he recognizes the significance of the finding. His position will be defenseless if the patient discovers the fistula and sinus infection several days later. Consultation with a qualified oral surgeon or rhinologist the same day is imperative.

Further consideration is given to problems relative to the maxillary sinus in that part of this chapter devoted to loss of roots in the antrum (p. 190).

Fracturing off of the maxillary tuberosity results from excessive posterior displacement of an upper third molar, usually associated with ankylosis of the root. In this situation also, the fragment should be left in place if it has good soft tissue attachment, and it should be removed if completely detached or seriously embarrassed as to blood supply.

Segments of alveolar process may remain attached to any tooth as it is being extracted, particularly when strong buccal or labial movements have been required. Such loss of bone may be virtually unavoidable in cases where there has been considerable obliteration of the peridental membrane by cemental spurs, and should occasion no dismay providing adjacent teeth are not divested of their supporting bone in the process, and providing the soft tissues are not unduly lacerated. *Excessive* fracturing or avulsion of alveolar process during the course of extraction is *prima facie* evidence of careless operative technic and indicates that tooth division or methodical bone removal should have been employed.

Fracturing of the lingual plate in the lower third molar region is generally the result of unskillful attempts to split an impacted tooth with the mallet and chisel, the principal *faux pas* being the directing of the chisel too much toward the lingual. Such forces should be in line with the long axis of the tooth. It must be remembered that the lingual wall of the socket is exceedingly thin in this region, and in some dry skulls a complete bony defect or window may be seen. The loose plate of bone resulting from this mishap will be slow to heal and will cause considerable pain as a result of movements of the tongue over it. If the segment is small and nearly detached it should be carefully removed; if large, it should be left in place.

Foreign Body Problems

A. *Broken injection needles* used to be much more of a problem than at present. Prior to the days of stainless steel needles it was

an ever present possibility, particularly in cases of impacted tooth removal. Abrasion of the cementum of an adjacent tooth will result in an annoyingly sensitive cervical area, or even in loosening and later loss of the tooth. Alveolar process, rather than the next tooth, should be used as the fulcrum for elevators.

Reference to the information leaflet given to patients contemplating removal of impacted teeth (p. 31) will recall that all of these people are advised that the adjacent teeth must be considered on probation for a period of three to six months. This blanket understanding is intended to cover situations where the unerupted tooth has denuded or resorbed the adjacent roots and is not to be taken as a license to mutilate the surrounding structures with surgical instruments.

The loss of a filling from a tooth adjacent to the one being extracted may be entirely unavoidable, for there may be recurrent caries around it, or the filling may have an overhang or poor contact. Any one of these defects could make loosening of the restoration inevitable. If the chance of this development is explained preoperatively, the proper arrangements for restoration of the tooth can readily be made. It is much more difficult to satisfy the patient if the explanation is given after the filling has fallen out.

(*b*) *Bone.—Accidental fracture of the mandible* by overzealous use of elevators should never occur if care is used in the application of force. Nevertheless this accident continues to happen to some unfortunate dentist every once in a while. As soon as the audible crack is heard the operation should be discontinued and the patient treated in the standard manner for fractures of the mandible. The tooth removal can be finished after healing is complete.

Fracturing of the floor of the sinus may result if unbridled force is used to remove a very solid upper molar which rests against a very large or thin-walled antrum. When these conditions are evident on the preoperative radiograph, a cautious approach should be used. Either tooth division and removal of each root separately, or performance of a flap procedure with bone removal and very gentle application of force would be indicated.

If the dentist is so luckless as to see the adjacent part of the maxilla move as he begins to manipulate an upper molar with the forceps he should stop immediately. If he does not feel qualified to continue the operation the patient may be referred to an oral surgeon at this point. Every effort should be made to conserve the fractured portion of the maxilla. Should a large segment of bone become completely detached, thus losing all of its blood supply, it must be removed. A meticulous repair of the gaping antral perforation must then be made so that a large fistulous opening will not remain.

Any fracture of the wall of the maxillary sinus, no matter how small, and whether linear, stellate, or punched out, must be considered the forerunner of bleeding into the antrum, with suppuration the probable sequel. The appropriate measures as to instruction of

surgeons of that era devoted a considerable portion of their practices to recovering broken needles, and many textbooks written in that period devoted several pages to the author's technic for handling the dilemma.

A reliable technic for recovering a needle broken during a mandibular injection, the most frequent situation, is as follows: A second injection is made in the conventional manner and the landmark needle detached from the syringe and left in place. Two extra-oral radiographs are made: a true lateral and a true P-A. These will confirm the fact that the lost needle lies in close proximity to the one which has just been inserted, which is virtually always the case. An incision is then made distally from the second molar, on up the ascending ramus for several centimeters. All tissues including the periosteum are retracted lingually by a hook or traction suture. The lingual nerve and vessels will be uninjured if the procedure is done as described. The soft tissues which have been drawn medially are carefully inspected and palpated. The open end of the needle may be seen as a black spot, or the stiffness may be detected by feeling with the fingertip. The Gilmore probe serves well to pick away fibers of tissue which may be covering the lost object. Recovery with a small hemostat is usually accomplished readily. The reasons for failure in most unsuccessful attempts at needle recovery are misinterpretation of radiographs and insufficient surgical exposure.

Recovery of a broken suture needle seldom presents a problem as some of it usually protrudes after breakage. Removal of a buried fragment should be along the lines of the procedure outlined above for injection needles.

B. *Debris such as fragments of amalgam, cement, or tooth structure* may fall back into lower extraction sockets, to remain as foreign bodies. Such an incident is, of course, a reflection on the skill of the operator and assistant, bearing mute testimony that the operation was done with poor visibility or gross carelessness. All loose particles of débris should be removed from the mouth immediately after they become detached. If considerable fragmentation of a crown is likely to occur, any nearby open sockets should be covered with a gauze square as a preventive measure. Postoperative radiographs should be taken whenever there is a possibility that some loose particle may have dropped into the alveolar wound.

Experience with shell fragment and land mine casualties has led most surgeons to feel that embedded metallic foreign bodies seldom produce chronic infection and removal of every bit of metal from some of these patients would be manifestly impossible. In the tooth extraction situation, however, it is unthinkable that any foreign material should be allowed to remain in the operative wound. Recovery of a foreign body discovered in the bone on routine *x*-ray examination is performed in the same manner as a buried root tip, for which the technic is described on page 162.

a fairly common occurrence for Novocain needles to break at the junction of the shaft with the hub, where rust had caused a weakness to develop. If the patient made a sudden movement when the needle was buried to the hilt and the needle snapped off, a rather serious situation existed. The mucosa would close over the broken end and the needle would be lost from view. The after effects of haphazard attempts to recover the broken needle were often rather severe, and failure to recover the lost object frequently resulted. The oral

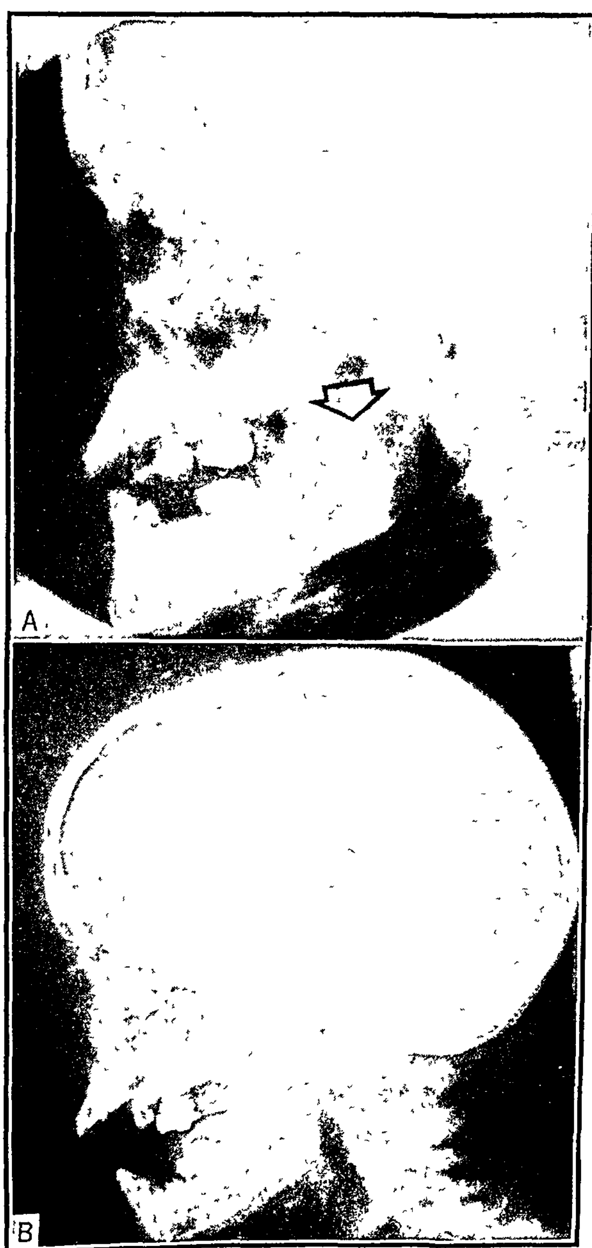


FIG 102 *A*, Broken mandibular injection needle, *B*, localizing needle in place (By chance, the two needles are nearly superimposed.)

teeth at the tip often serves well for this purpose. The dental foil carrier should not be used as there are no teeth and repeated slippage results. Retrieving a small root tip is, paradoxically, much more difficult than recovery of an entire tooth. The long, slender nasal dressing forceps is a good instrument to select for securely grasping the elusive root.

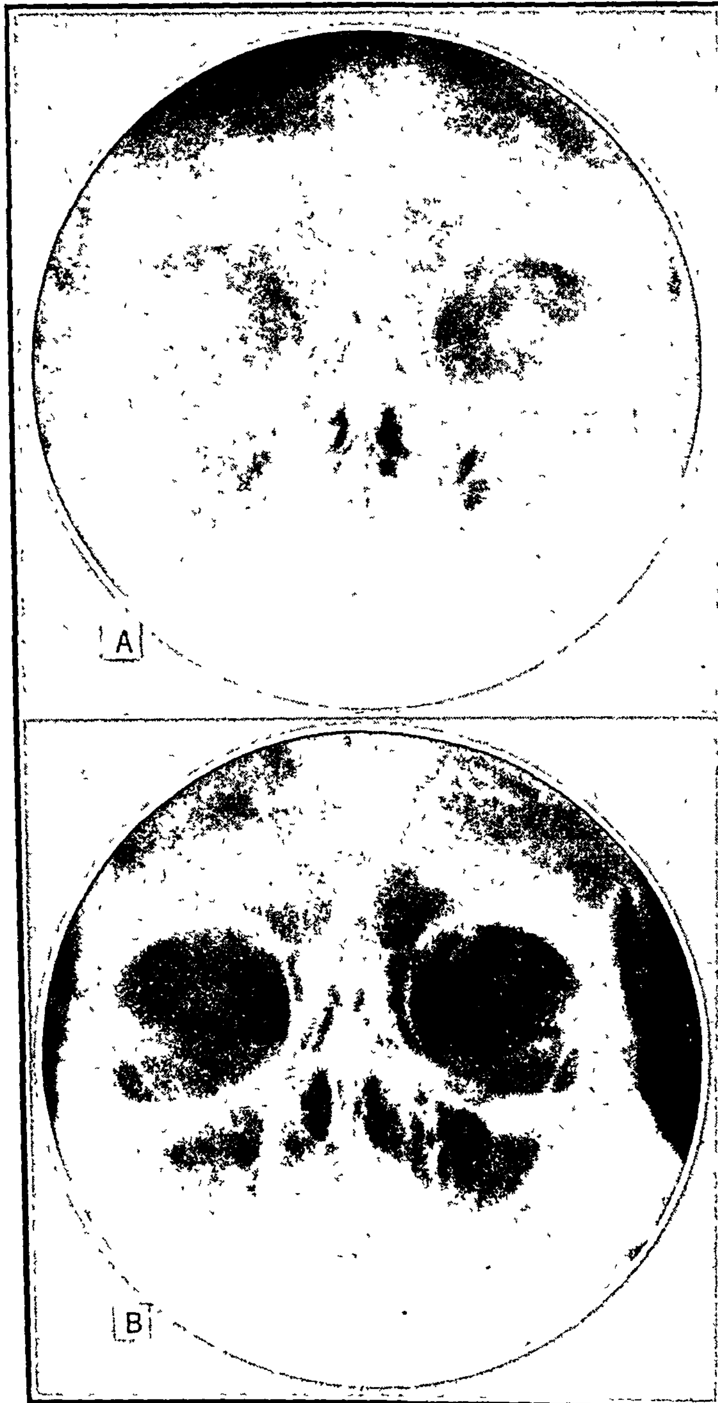


Fig 104. *A*, Third molar lost in maxillary sinus; *B*, appearance after removal by means of Caldwell-Luc operation

C. *Loss of a Tooth or Root in an Anatomical Space.* (*a*) *Soft Tissue Compartments.* Loss of a tooth or part of a tooth in the sphenomaxillary fossa, submandibular fossa, or other soft tissue space is virtually always the result of working with poor vision and access. Every experienced operator knows that if such a thing happens to him, his technic has been faulty somewhere along the line. Recovery of an entire tooth which has been so displaced calls for wide exposure, good hemostasis, and brilliant illumination. The tooth should not be touched by any instrument which might tend to push it further into the tissues. A large curved hemostat with

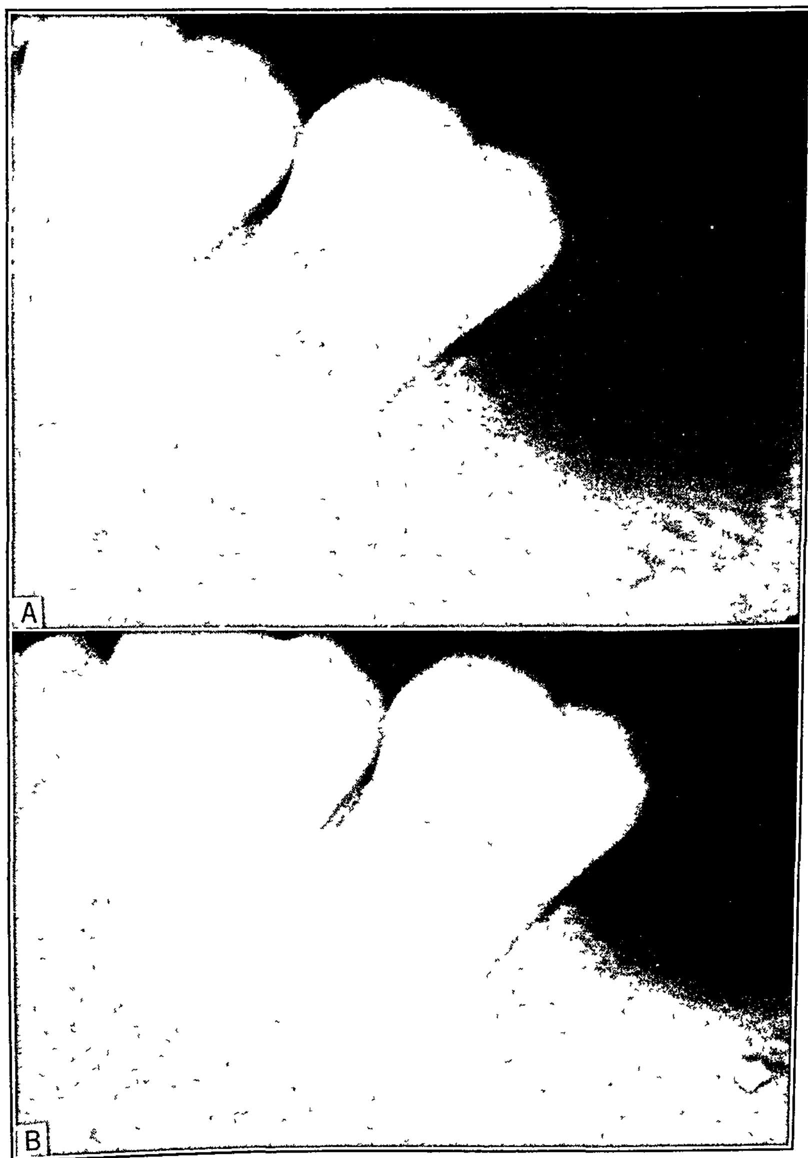


FIG 103 Foreign body (amalgam) in alveolus The possibility of artifact is ruled out by taking two exposures

Dental and occlusal plane radiographs should be taken to learn whether there truly is a lost object in the sinus, and the antrum should never be invaded without positive evidence that the root is in the antrum.

If the radiographs indicate that the lost root tip is lying immediately adjacent to the point of entry, the calculated risk of the attempt for removal through the socket may be considered, since a small opening already does exist. Two rigid criteria must be fulfilled, however, to justify this unconventional procedure. First, the antrum must not be grossly contaminated in the process. Second, the wound must be left completely closed to prevent the ingress of food or liquids, so that continual contamination with oral organisms cannot occur.

Fortified with the evidence revealed by radiographs, the dentist deliberately enlarges the opening through which the root has passed, by the cautious use of a small chisel or curet. With the aid of his headlight beam he may be able to promptly visualize and remove the root with the double-ended curet. If it cannot be found within a few minutes, it is better to abandon this method in favor of the *Caldwell-Luc* approach.

Sometimes, upon studying the situation after the bony opening has been slightly enlarged, the operator will be fortunate enough to find that although the bony wall of the antrum is opened the lining membrane is intact, and the root lies between them. This situation is infinitely more favorable, for there will be no bleeding into the antrum and infection will not develop.

After recovery of the root fragment through the socket, further radiographs should be taken to record the fact and the soft tissues must be completely closed. Two principal methods are effective.

1. After the replacement with sutures of the conventional flap, the socket opening may be covered with any type of dressing or improvised appliance which excludes food and liquids but *permits formation of a blood clot within the entire bony socket.* This may be accomplished with a saddle of base plate material or modelling compound if some way can be found to secure it in place for seven to ten days. The same effect may be achieved by suturing a small pad of iodoform gauze, two or three layers thick, across the orifice.

2. The other method of management of the socket is to suture it shut. Everything that has been said in earlier chapters regarding advancement of flaps, suturing without tension, and covering all exposed bone with mucous membrane must be remembered. Occasionally, enough collapse of the socket will have occurred from bone removal incident to the extraction. In other cases, bone will have to be cut back with rongeurs so that the buccal and lingual soft tissues may be coapted, raw against raw surface, and sutured together without tension. In most instances it will be necessary to draw the buccal flap far to the buccal and incise the periosteum horizontally at the level of the root apices for a distance of 2 or 3 centimeters. This should give ample relaxation, but to test for this

(*b*) *Bony Compartments.* A small root tip may become displaced into the *mandibular canal* in the course of removal of an impacted lower third molar. Logical deduction will lead to the realization that the wall of the canal was probably frail to begin with, and a slender instrument such as the Gilmore probe can often successfully lift up the delicate fractured plate of bone which has been concealing the root tip up to that point. If bleeding obscures the field a small wisp of gauze soaked in epinephrine should be left in place for one or two minutes before further attempts are made.

Loss of a root tip or entire tooth in the *maxillary sinus* is an ever present possibility in all surgical procedures upon upper posterior teeth. Any foreign body in the antrum will lead to severe, stubborn infection, and when there is a concomitant opening into the oral cavity, no matter how small, the establishment of an antra-oral fistula ensues as a matter of course, since drainage seeks the lowest point for egress.

It will be remembered that the columnar ciliated epithelium lining the antrum is identical with that covering the interior of the nasal passages. When one considers the irritation produced in the nose even from dust particles or smoke, he can readily understand the havoc that follows when a gross foreign body becomes lodged against this delicate membrane. The ciliated epithelium can successfully expel liquid material from the ostium beneath the middle turbinate, if given sufficient time, and if infection does not occur. The elimination of any but the tiniest foreign body is impossible by this means.

The antrum is essentially sterile, whereas the oral cavity teems with organisms of many types. Contamination of the antrum through irrigation with nonsterile solutions, or manipulations within it by instruments contaminated with oral organisms will often lead to severe suppurative sinusitis. It can readily be seen that well-intentioned but misguided efforts to retrieve a root tip or tooth through the accidental sinus opening are destined to lead to sinusitis and antra-oral fistula in a high percentage of cases. Referral of the patient to a competent oral surgeon or rhinologist at this point should be seriously considered.

The proper management of these cases calls for a careful review of the patient's history, a frank appraisal of the existing situation, and a willingness to recognize one's surgical limitations. An effort should be made to determine whether the patient has previously existing chronic sinusitis, as the treatment for such cases is more complex than that for an antrum which was normal up to the time of the attempted extraction.

The dentist should not be too quick to assume that a root tip has been lost in the antrum, even though he has momentarily lost track of it during the process of attempted removal. Gravity will cause some of these tiny objects to fall into the floor of the mouth or they may pass to any part of the oral cavity during an unguarded moment. They may go up the suction aspirator or be spit into the cuspidor.

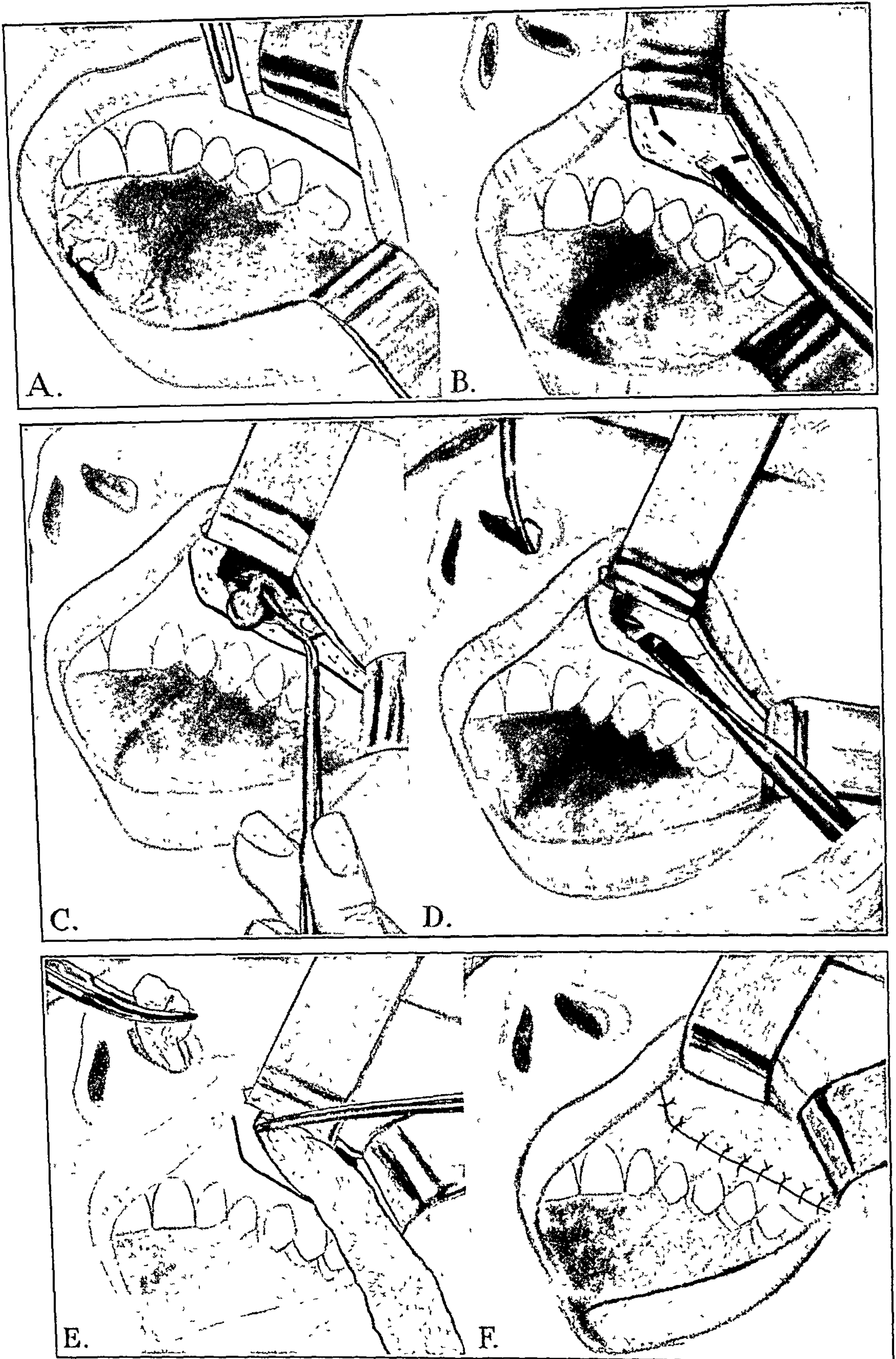


FIG 106 The Caldwell-Luc operation *A*, Incision; *B*, entrance to antrum in canine fossa; *C*, removal of diseased tissue; *D*, construction of naso-antral window; *E*, insertion of iodoform gauze dressing; *F*, closure.

factor the flap should be drawn even farther lingually than the lingual socket margin, to make sure there will be no tension on the sutures. Closure is by interrupted simple or mattress sutures.

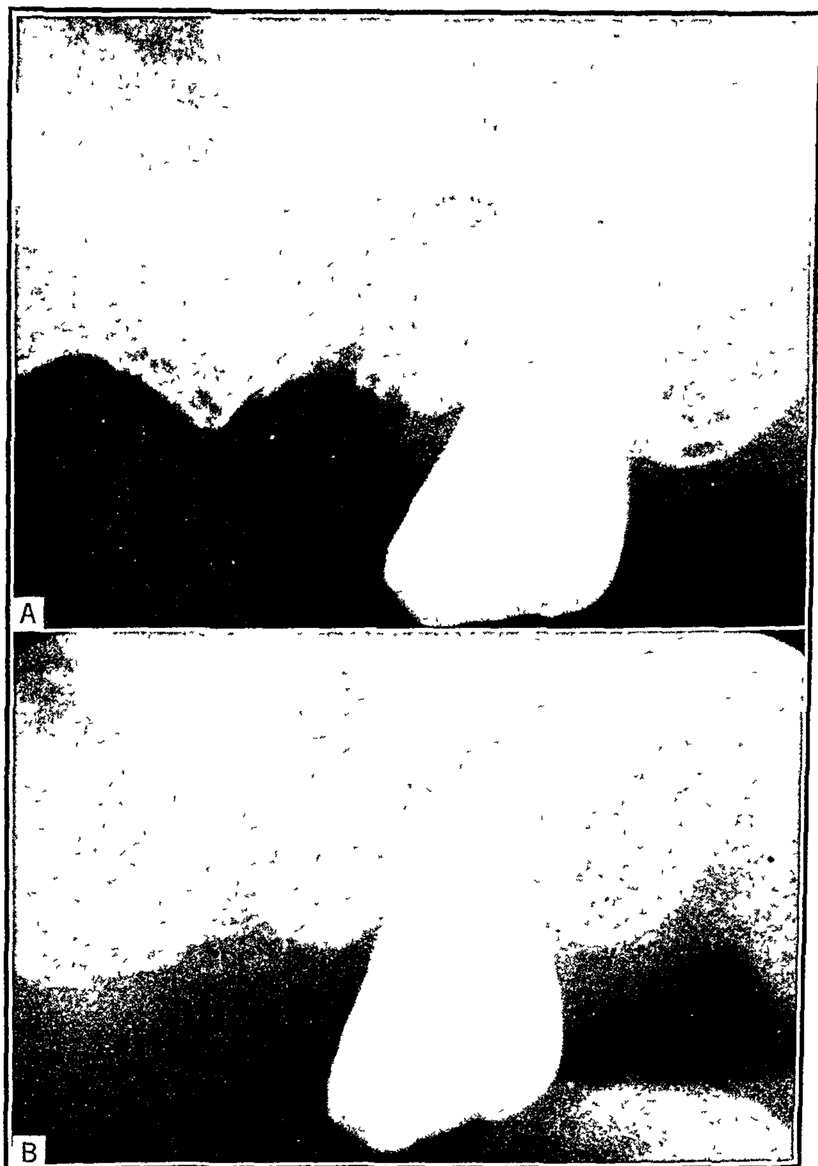


FIG 105 *A*, Lingual root of second molar displaced into the antrum, *B*, appearance after removal through extraction wound (see text)

When an entire tooth is lost in the sinus it is virtually always the third molar. Most of these accidents are caused by the use of extraction forceps on an incompletely exposed crown. The tooth becomes projected upward as the beaks snap shut.

For removal of an entire tooth, and for removal of all root tips which are not lying very close to the socket opening, the only

It is often helpful to reinject with local anesthetic solution containing a vasoconstrictor. This will either stop the bleeding or markedly reduce it so that packing can be done more carefully. If bleeding persists in spite of these measures the patient should be given the full therapeutic dose of morphine sulphate, $\frac{1}{4}$ grain (.016 gram) for men and $\frac{1}{6}$ grain (.010 gram) for women, providing no similar medication has already been given.

If the bleeding still continues, arrangements should be made for hospitalization, blood studies, and transfusion if necessary. Fortunately, these extreme measures are seldom needed, but it is well for every dentist to have plans laid in advance for every serious emergency which might occur.

Whenever a patient requires many extractions it is a good plan to limit the amount of surgery performed at the first sitting to a minimum. This permits not only a good check on the blood clotting mechanism, but also an evaluation of the patient's tolerance for surgical trauma, behavior under stress, and general willingness to cooperate.

Secondary hemorrhage is nearly always associated with sepsis. It is usually assumed that a clot has become liquefied by pathogenic organisms or that a vessel wall has become eroded by the destructive action of bacterial toxins. The measures used to arrest the bleeding are essentially the same as those which have just been described for primary hemorrhage. Antibiotic therapy and other measures appropriate for the combatting of infection should be instituted.

Postoperative bleeding may take the form of a slight, persistent, generalized ooze into the mouth, or the same process may cause the blood to seep out into the tissues of the face and jaws. If the result is merely that of ecchymosis—deep purplish pigmentation of the face and neck—there will be little interference with healing. If, on the other hand, a large pool forms, *i.e.* a hematoma, healing will be delayed and infection may supervene. In the more major jaw operations pressure dressings are used to minimize postoperative capillary ooze. Unfortunately it is rather impractical to apply this principle to dento-alveolar surgery and the best that one can do is to try to clamp and tie, at the time of surgery, all vessels that are likely to bleed, and be sure the patient understands how to apply pressure, remain quiet, and carry out the other measures indicated to control bleeding.

Hemorrhage from the nose may occur following surgery in the posterior maxillary or hard palate regions, and is, of course, associated with a tear of the lining membrane of the nose or antrum. Packing of the nose will seldom if ever be required. Conservative measures such as the use of sedatives, elevation of the head, and application of ice packs will usually cause the bleeding to subside.

Local Postoperative Infection

The management of infections of the jaws arising from dental disease is discussed in a separate chapter of this text (p. 315). The

method which can be recommended is the *Caldwell-Luc* approach through the canine fossa. This is a distinctly advanced procedure, and is not recommended for the dentist who has not had considerable training and experience in major oral surgery. The operation provides a view of the inside of the entire antrum and the operative wound may be closed so that there is no likelihood of a fistula developing from it. The steps of the operation are illustrated in figure 106.

D. *Aspiration or swallowing of foreign bodies* such as root tips, teeth, or portions of dental restorations may occur during general anesthesia in spite of eternal vigilance. The patient should be immediately placed under the care of a physician well trained in the art of endoscopy. Although passage of such objects into the esophagus is seldom serious unless they have sharp projections, patients who have this accident should be examined by a competent specialist, for it cannot always be determined whether the object was aspirated or swallowed, until P-A and lateral chest *x*-rays have been taken.

Accidental Injection

The dentist is responsible for the after effects of any injection or irrigation he performs, even though the solution may have been prepared by others. Phenol, cocaine, Zephiran, photographic fixing solution, and alcohol have been known to be injected accidentally or used to irrigate cavities or tracts. When Luer syringes are being used, the operator must make absolutely certain that the solution he is to inject could not have been accidentally drawn from the wrong vial or flask.

Accidental Burning

The use of phenol, silver nitrate, or actual cautery in the oral cavity calls for meticulous care to make certain that all adjacent areas are protected by bats of wet cotton or gauze. The hazard is increased with the use of the electric cautery near structures that have no sensation because of local anesthesia, for obvious reasons.

Hemorrhage

The bleeding which occurs during an operation is spoken of as *primary*, and that which comes on several hours or days afterward is known as *secondary* hemorrhage. Excessive bleeding during the operation should be managed by clamping and tying if the vessel is in soft tissue and crushing with a blunt instrument if in bone. Placement of one or two figure 8 stitch ties (see Fig. 53) may arrest the bleeding quickly and with a minimum of effort. Persistent bleeding in a bony cavity should be managed by packing with iodoform gauze strip lightly coated with some form of ointment such as acrithesin, or better still with oxidized cellulose, or gelatin sponge saturated with bovine thrombin. Packs soaked with epinephrine may be used, but bleeding which is controlled in this manner frequently recurs after the effect of the drug has worn off.

either from failure of a blood clot to form in the socket after extraction, or from the loss of the clot due to mechanical factors or bacterial lysis. Exposed alveolar bone is invariably attended by pain and a greater or lesser degree of infection. Since bone is able to give only a rather feeble defense against infection, largely because it is not as vascular as soft tissue, necrosis of some portion frequently occurs whenever osseous tissue becomes infected. Elimination of dead bone by the body, whether by osteoclastic activity or sequestration, takes a long time.

The *symptoms* of dry socket are easily recognized. First there is pain, beginning on the second to fourth day after extraction. It is steady, severe, and radiating. The remains of the blood clot have a foul odor and are highly irritating to the unprotected socket wall. Even though protective sedative dressings are used, the process often continues for an average of ten to fourteen days. At the end of this time the socket fills in with granulation tissue with or without the formation of a bony sequestrum.

Treatment is directed at relieving the discomfort and promoting healing. One of the most popular dressings is the proprietary Ward's Pack, made by mixing equal quantities of the powder and liquid with a small amount of sterile petrolatum and cotton fiber. The socket is gently irrigated and dried before placement of the dressing. The patient should be instructed to return if the pain is not relieved or as soon as discomfort returns. Dressings are changed as necessary every few days until healing is established. Another form of dressing, which has the advantage of not forming a hard mass but the disadvantage of becoming enmeshed in new granulation tissue, is a short length of half-inch iodoform gauze anointed with acrithesin ointment.

The use of antibiotic ointments has been recommended by Cipes, who treated 45 cases with a 2 per cent aureomycin paste. All but 5 responded favorably.[2] Zeff, working with an ointment consisting of 1000 units of calcium penicillin per cubic centimeter in U.S.P. petrolatum had good results in all of 25 cases.[3]

Denuded Bone. In any case where the soft tissue covering sloughs or becomes displaced due to improper suturing, bone will be exposed to the fluids of the mouth, and osteitis, manifested by pain, will be the invariable result.

Osteitis and Osteomyelitis. As will be emphasized in the chapter on infections, there is no clear-cut line between soft tissue and bone infections of the jaws, nor between the minor and the major degrees of infection. Thus it is not always possible to discriminate between osteitis and osteomyelitis when they are under consideration as a postoperative complication. Since the elements of treatment are essentially the same, differing only in the vigor with which they are applied, the distinction is not too important. Either one is serious, but full-blown osteomyelitis constitutes a major disaster.

Maxillary sinusitis has already been discussed as the end result of perforation, bleeding into the antrum, or loss of a root therein.

care of infections is essentially the same whether they have developed from untreated dental disease or whether they follow surgical intervention. Some types are directly associated with the operation itself, and will be discussed here.

Soft Tissue Infections

Soft tissue infections which may result directly from the operation are of two types. The first is an *abscess* formed beneath the mucoperiosteal flap, more particularly beneath that portion which overlies a plateau of undisturbed bone. The condition is probably due in all instances to entrapped bone dust or spicules which are overlooked when the wound is being policed immediately before closure. The clue to prevention is quite evident; a very thorough search for such foreign matter should be made before wound closure, particularly in the recesses far underneath, at the base of the flap. This complication sometimes occurs under the palatal flap used for removal of impacted cuspids or supernumeraries. When it forms after lower third molar impaction removal, the pathological mechanism is particularly clear, for the socket may be healing well, whereas there is a localized buccal abscess alongside the first and second molars. In all such cases the wound should be reopened and drainage established.

The second type of soft tissue infection which must be laid at the door of the operator himself is the so-called *needle abscess*. The most striking example is that which develops in the lateral pharyngeal space following mandibular block anesthesia. Severe trismus, dysphagia, pain, and rather severe constitutional symptoms of infection are present. Careful examination with the tongue blade and headlight will reveal that the affected side of the soft palate does not rise on phonation and a broad mass is seen between the tonsil and the third molar area. Under light general anesthesia, incision and drainage, along the path traversed by the local anesthetic needle, will usually result in a gratifying flow of foul pus. A rubber dam drain should be left in place and the usual supportive measures for all intra-oral infections energetically applied.

A needle abscess following injection in the region of the tuberosity may assume serious proportions. Less serious forms may occur in any area of the oral cavity which has been reached by the point of the injection needle.

Bone Infections

Bone infections following tooth removal operations are also characterized by certain features that distinguish them from those resulting from untreated dental disease.

Dry Socket. Most authorities are dissatisfied with this term but all continue to use it, for the meaning seems to be well understood. The alternate terms of postoperative osteitis, localized osteomyelitis, and postextraction alveolalgia have been suggested. The *cause* of this condition is not known. It is presumed that it results

stored. Aromatic spirits of ammonia is a time honored inhalant. If the circulatory tone does not return promptly, or if the patient continues to feel faint when returned to the upright position, nikethamide (Coramine) 1.5 cc. may be injected intramuscularly or intravenously. Although this preparation is essentially a stimulant of the higher centers, if often helps. If the operation can be concluded promptly and the patient allowed to lie down in a quiet retiring room away from the surgical atmosphere, recovery results almost immediately.

It is a fact worth noting that virtually without exception people who faint in the dental chair apologize for their behavior, and hold no ill feeling toward the dentist. There would seem to be no gain in the dentist's attempting to dissuade the patient from this point of view!

The more severe forms of shock resulting from crushing wounds, burns, or massive hemorrhage will be considered in the chapter on injuries, p. 262.

Allergic and Drug Reactions. Any drug or pharmaceutical preparation introduced into the body is capable of producing toxic or allergic reactions. Nausea, vomiting, diarrhea, edema, urticaria, asthma, spontaneous hemorrhages, dizziness, convulsions, or unconsciousness should be ascribed to these causes until proven otherwise.

Symptomatic treatment of effects which are felt to be due to the toxicity of a local anesthetic or vasoconstrictor calls for stimulating drugs and oxygen if the reaction is that of depression, and for sedative and depressant drugs if the patient is excited and overstimulated. Fortunately few patients exhibit the classical signs of procaine or epinephrine toxicity.

The incidence of toxic effects from acetylsalicylic acid and pentobarbital sodium is so low that these two substances are considered safe for routine use. However, at the first sign of any abnormal symptoms all medications should be stopped immediately and appropriate measures taken to treat the complication. Deaths have been known to occur from a few drops of procaine, or from 1 phenobarbital tablet.

False pride should not cause a dentist to delay summoning medical aid when he encounters an apparent toxic or allergic reaction. The practice of dentistry requires that many calculated risks be undertaken daily. When commonly used agents produce harmful effects, the question is not one of fault but rather that of the need for prompt remedial therapy

Bacteremia and its sequellæ have already been discussed (p. 35).

Weight Loss. Many patients undergoing multiple tooth removal operations will complain of weight loss and general body weakness, ascribing it to the fact that their mouth is sore and they cannot eat properly. Since overweight is a common abnormality, the complaint is often tempered with the whimsical remark that this is a good thing! The matter of reduction of total body weight is not so important as the failure to keep up the intake of food elements

Details of management of this postoperative complication are given in the chapter on infections, p. 315.

SYSTEMIC COMPLICATIONS

Syncope is a severe disturbance of the circulatory system, usually coming on suddenly, which results in low blood pressure, thready pulse, pallor, clammy skin, perspiration, and loss of consciousness, often with a brief convulsion. The condition has many causes. The simplest form, *psychic shock,* may result from nothing more than hearing bad news, viewing a street accident, or watching an operation. The mechanism in these cases is probably due to action of the cerebral cortex upon circulatory control centers in the brain stem, which in turn affect the autonomic nervous system, temporarily deranging it so that peripheral vasodilatation occurs. The latter produces the sudden fall in blood pressure with the inevitable cerebral anemia and unconsciousness.

The condition tends to be self corrective inasmuch as a standing individual falls, assuming a horizontal position, so that blood returns to the brain and consciousness returns. When this simple form of syncope develops in a patient who is sitting erect in the dental chair the primary treatment should be to immediately lower the head and to maintain this position until the peripheral circulatory tone has been restored.

Many studies have been conducted to attempt to find out whether there is one single factor which produces most of the cases of fainting in the dental chair. The usual conclusion resulting from these investigations is that the psychic factor probably plays a large part in all cases, although drug toxicity or sensitivity to some component of the local anesthetic solution can be shown to be a factor in some instances.

Premedication with barbiturates reduces the number and severity of these incidents, but it is difficult to prove whether the benefit comes from allaying apprehension or from a true antagonistic effect against the toxicity of the local anesthetic agent and vasoconstrictor.

It was once felt that sudden syncope following local anesthetic injection resulted from accidental intravenous injection of the solution. This theory lost some support with the advent of the practice, now common, of injecting procaine intravenously in the treatment of severe burns and other medical conditions Furthermore, it is difficult to see how intravascular injection could occur so frequently when it is recalled how much difficulty is experienced by a novice in making an intentional intravenous injection into a distended vein in the arm.

Whatever the cause of this form of shock may be, the treatment, in addition to lowering of the head, is symptomatic. Tight clothing should be loosened, the patient should be covered, if cold, or allowed to breathe fresh air if he complains he is too warm. A sip of ice water is often gratefully received when consciousness has been re-

With these thoughts in mind the practicing dentist would do well to consider whether it is wise to boast that he does all his own surgery, or that he has never had to call for consultation. It may be possible, but is it worth it?

REFERENCES

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2 CIPES, L R : Aureomycin, New York D J., *16*, 450, 1950.
3 ZEFF, S : Penicillin ointment in postoperative infection of the alveolus, J. Oral Surg , *5*, 345, 1947.

necessary for the healing and repair of the surgical wounds. These patients must be reminded to reread their postoperative instructions carefully and to follow the suggestions in order that their wounds shall heal promptly.

Death, the ultimate complication, may occur in the dentist's office even though no treatment is in progress, even as it can occur on the street corner or in an easy chair at home. Throughout this book precautions and suggestions are given which should help the dentist to protect his patients from disaster while under treatment. A large share of the deaths are the consequence of some difficulty under general anesthesia. The man in general practice should therefore be aware that by abstaining from the use of such agents he is minimizing the likelihood of having a death in his office. At the same time, if he plans to use general anesthesia he should thoughtfully contemplate the need for thorough training and experience in this type of activity.

Sudden deaths, other than those under general anesthesia, are always possible, but the use of reasonable caution should enable the dentist to exclude those who would constitute bad risks for office oral surgery.

In the event of the demise of a patient in his office the dentist should immediately summon a physician, who will be able to view the situation objectively, and give practical suggestions regarding the disposition of the body, notification of relatives, and reporting the case to the coroner if he feels it is necessary. The physician will perform the necessary official pronouncement of death, and fill out the death certificate.

CONSULTATION AND REFERRAL

Although these matters are taken up at length in the last chapter of the book, a few words should be said here to emphasize the fact that "It is not given unto any man to know all things." Whenever complications set in, it is the courageous man who most readily admits that he may be dealing with something beyond his knowledge and experience.

There is an old saying to the effect that "We never learn by doing things right." An adverse development should not be viewed as a form of bad luck, but should be studied for the lesson it has to tell. Sometimes the dentist did improperly something which he knew very well how to do correctly—in other words, he was careless. At other times it is a question of having strayed beyond the boundary of his easy operating range. On still other occasions it is a question of the "odds catching up with him." No type of treatment is devoid of all risk, and some procedures carry a standard percentage of failures, as in the case of certain very serious major operations where the statistical chance for mortality may be 15 or 20 per cent.

been described, in most instances, in the chapter on Basic Oral Surgical Technics, p. 174.

Although oral neoplasms could be classified in many different ways, for purposes of this discussion the growths which the dentist is likely to encounter have been separated into benign and malignant, then subdivided into groups according to the usual site of occurrence.

Cysts of the jaws are considered in this chapter, as such a grouping has been suggested by Thoma,[1] and the surgical care of hollow lesions is much the same as that for benign tumors.

Biopsy

It must again be emphasized that the making of a diagnosis should be the result of an orderly sequence of history, examination, and the use of well-selected laboratory aids. The value of the biopsy in diagnosing any lump, mass, or ulcer cannot be overstressed.

There are only three situations where a biopsy is not to be done. The first is in the care of benign bony lesions known as exostoses or tori. When such a mass is in the midline of the palate (torus palatinus) or on the lingual of the mandibular bicuspid region (torus mandibularis), the diagnosis may safely be made on sight, and removal accomplished without first taking a biopsy. The second is the hemangioma, where partial excision might produce very serious bleeding. The third is the malignant melanoma, for which no surgery except wide excision should be done, for fear that early and widespread metastasis of this most malignant lesion may be caused by the stimulation of surgical manipulation. For all other tumors the taking of a biopsy is always good practice and frequently necessary for the making of an exact diagnosis. The actual technics for biopsy and excision biopsy have been described on pp. 143 and 144.

Two common beliefs about biopsies should be briefly mentioned and refuted. The first is that this procedure disturbs the cancer (if present) and will cause it to metastasize. Bell states there is no conclusive evidence that taking a specimen from a malignant tumor causes metastases and the value of a positive diagnosis would outweigh this slight hazard in any event.[2] The second concerns the legality or propriety of a dentist's taking a biopsy. There is such an overwhelming volume of medical as well as dental opinion to the effect that it is not only the privilege but the duty of the dentist to do so, that the question may be assumed to be settled. The diagnosing of malignant disease within the oral cavity represents a lifesaving measure when it can be done early in the disease.

Although a single biopsy is usually sufficient for the making of a diagnosis, occasionally two or even three samples may have to be taken, since tumors often have different cellular structures in different areas. Also, the first biopsy may not have been sufficiently large or deep, and fixation or sectioning may have been improperly done.

9

Tumors and Tumor-like Conditions

VOCABULARY*

Tumor. From the surgical point of view a tumor is a swelling or morbid enlargement From the pathological standpoint a tumor is a mass of new tissue which persists and grows independently of its surrounding structures, and which has no physiologic use

Neoplasm. *Any new and abnormal growth, such as a tumor.*

Epulis. A fibrous tumor of the gums, usually seated on the periosteum or bone of the jaw.

Benign. Not malignant, not recurrent, favorable for recovery

Benign Tumor. Any tumor not likely to recur after removal; an innocent tumor

Malignant. Virulent, and tending to go from bad to worse

Malignant Tumor. One which is likely to recur and eventually to destroy life.

Cancer. Any malignant tumor

Carcinoma. A malignant new growth made up of epithelial cells tending to infiltrate the surrounding tissues and give rise to metastases.

Metastasis. The transfer of disease from one organ or part to another not directly connected with it It may be due either to the transfer of pathogenic organisms or to transfer of cells, as in malignant tumors

Biopsy. Inspection of the living body, as opposed to necropsy, especially diagnostic examination of a piece of tissue removed from a living subject.

Excise. To cut out or off

Enucleate. To remove whole and clean, as a tumor from its envelope

The care of tumors and tumor-like lesions constitutes one of the most fascinating phases of oral surgery. It brings into play the scientific knowledge the dental student has acquired in his studies of general and special oral pathology. In many cases the dentist is the best man to diagnose and treat oral tumors, for he will be the first examiner to see them, and with the skills and equipment at his disposal he is well qualified to remove small benign lesions and to secure tissue for diagnosis of the more serious disorders.

Complete pathological descriptions of the various lesions will not be given, as this information is to be found in the standard texts on general and oral pathology. The surgical treatment for those conditions which are amenable to removal by the dentist has already

* All definitions are from Dorland, W. A. N · *The American Illustrated Medical Dictionary*, 22nd ed., Philadelphia, W B Saunders Co , 1951

bone, in which case the diagnosis of *fibro-osteoma* or *osteofibroma* applies.

Treatment of the peripheral lesions consists in excision from their base, and of the central type enucleation from their bony bed.

A soft, compressible, dark red or purplish mass should be identified on sight as a *hemangioma*. Favorite locations for this tumor are the lips and cheeks. Treatment is by the injection of sclerosing solutions such as sodium morrhuate to obliterate the large vascular spaces, or by total excision. Biopsy of a portion of the mass should not be done, due to the hazard of profuse bleeding.



FIG 108 Hemangioma, *A*, before treatment, and *B*, after injection with sclerosing solution (Tam, courtesy of D Digest)

Lipomas are seen rather rarely. They are soft, well-encapsulated, freely movable spherical or ovoid masses consisting of bright yellow fatty tissue, usually found in the cheek or floor of the mouth. They are removed in the same manner as a cyst of the soft tissues.

Mixed tumors may be found in any region where there are mucous or serous glands. The parotid gland and posterior part of the hard palate are the most frequent sites of occurrence. Removal of a parotid mixed tumor would not fall within the field of general dentistry, and even the intra-oral type should be approached with caution, for they are not always well encapsulated, and removal should be complete on the first attempt. The stimulation of attempted surgical excision may incite a mixed tumor to undergo malignant transformation. Berger reported complete cure of 12 intra-oral cases following complete surgical enucleation.[3]

Giant cell tumor may arise on the gingiva as one form of *epulis*, in which case it is spoken of as a peripheral giant cell tumor. The histological appearance is indistinguishable from that of the central giant cell tumor. The *treatment* of this, as well as other types of epulis, consists of excision, with complete destruction of the site of

While it is proper to assume that every qualified pathologist is competent to make a diagnosis when he is presented with a good slide from a lesion, there are some rare conditions on which the experts disagree. The dentist in general practice is not likely to become involved in this dilemma, for if he were dealing with such a curiosity he would probably refer it to someone with wider experience in tumor pathology and treatment.

BENIGN SOFT TISSUE TUMORS

Virtually every type of cell is capable of forming a tumor. Only those which are commonly seen in the mouth or are of unusual interest to the dentist will be discussed.



FIG 107 Benign polyp.

Papillomas are seen on the tongue, cheeks, and soft palate, usually as small, pedunculated, cauliflower-like masses consisting of proliferated epithelium supported by a stalk of vascular connective tissue.

Polyps occur frequently on the inner surface of the cheek, and may be found on any part of the mucous membrane. They appear as smooth, soft, painless, movable lesions arising from a narrow pedicle. The covering epithelium is of normal color.

Biopsy excision of either of these growths is readily performed in the manner described on page 143.

Fibromas may occur in the form of a peripheral lesion (polyp or epulis) or as a central lesion within the substance of the jaw. The latter abnormalities are considered by some authorities to be examples of *fibrous dysplasia of bone.* Either variety may contain



FIG. 110. Peripheral giant cell tumor *A*, Preoperative, and *B*, Postoperative appearance. (Case of Dr J. C. Tam, courtesy of North-West Dent.)

BENIGN TUMOR-LIKE CONDITIONS OF SOFT TISSUE

Patients who have been wearing full dentures, especially immediate dentures which have not been relined, frequently exhibit some degree of injury of the oral tissues due to irritation or trauma produced by the prosthesis. Since the injury develops slowly the patient's complaint is often limited to the remark that the dentures no longer fit. Examination will reveal flabby folds of scar tissue covered by essentially normal epithelium. These changes are spoken of as *scar tissue growths due to ill-fitting dentures*, *denture injury tumors*, or *inflammatory gingival hyperplasia*. Acute infection may develop in the depths of the folds, resulting in pain and increased vascularity. This promptly subsides if the denture is left out for one or two weeks, or if the periphery of the appliance is drastically cut back with a vulcanite bur.

origin, which is usually at the junction of the periosteum with the periodontal membrane of a tooth. Chemical or thermal cautery should be used, and recurrence often follows unless the involved tooth or teeth are extracted.

Benign moles occur very rarely on the oral mucosa.[4] If pigmentation is present, they should be considered potentially malignant at the time of discovery and referral for wide excision both in breadth and depth is indicated.

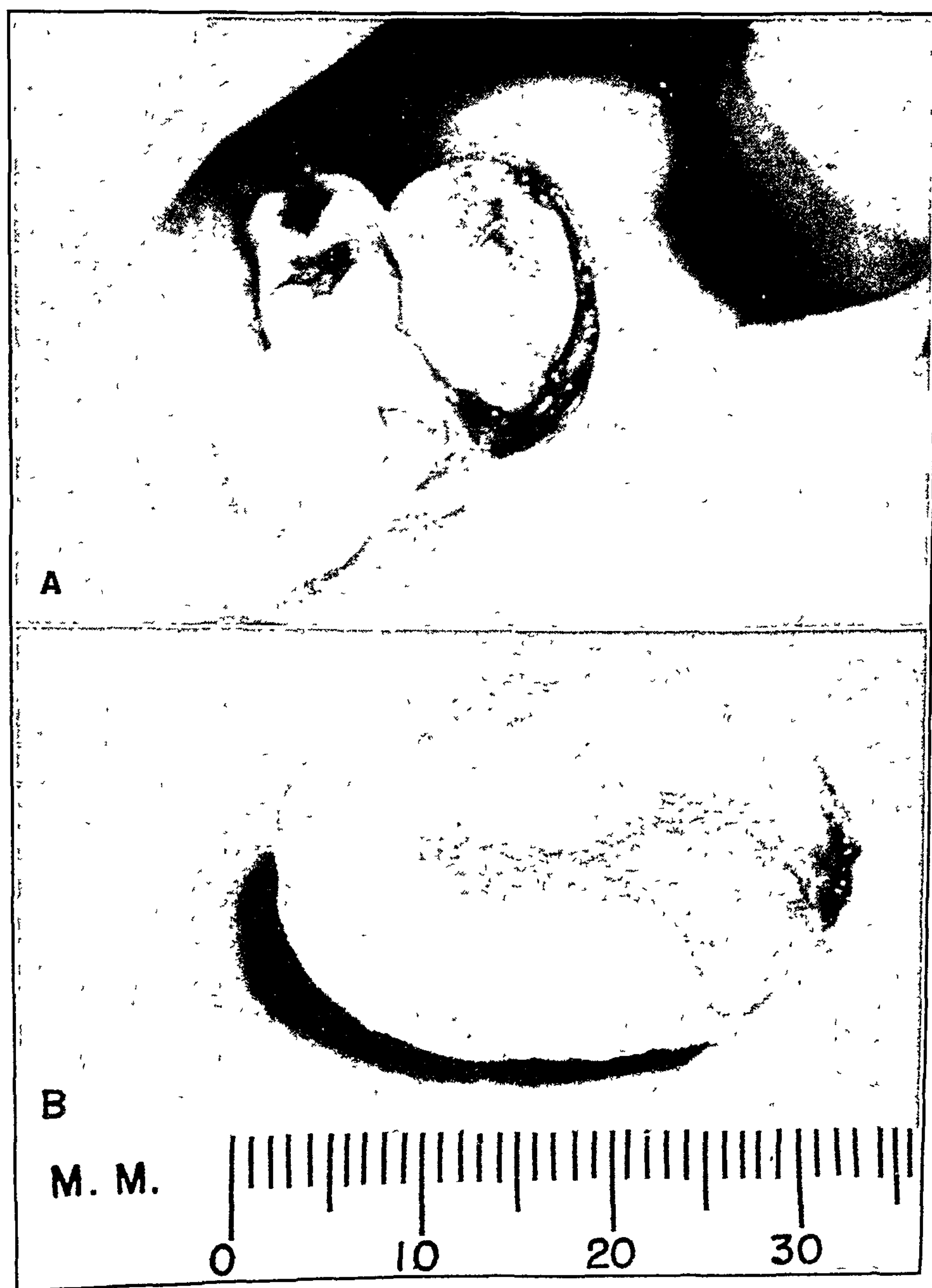


FIG. 109. Lipoma, *A*, in process of removal, and *B*, specimen (Case of Dr D E Brannin)

In outlining the *treatment* for patients with denture injury tumors, two basic facts must be kept in mind. First, the patient with this condition is a habitual denture wearer, and will be satisfied with even slight improvement in the fit and retention of his new denture. Second, the surgical procedures that might be considered are either very simple or quite complex. The inference is that the dentist in general practice can do a great service to many patients by simply excising redundant folds and flabby ridges, then making new dentures. The number of patients who need the rather elaborate flap advancement procedures for deepening of labial and buccal sulci is very small indeed.

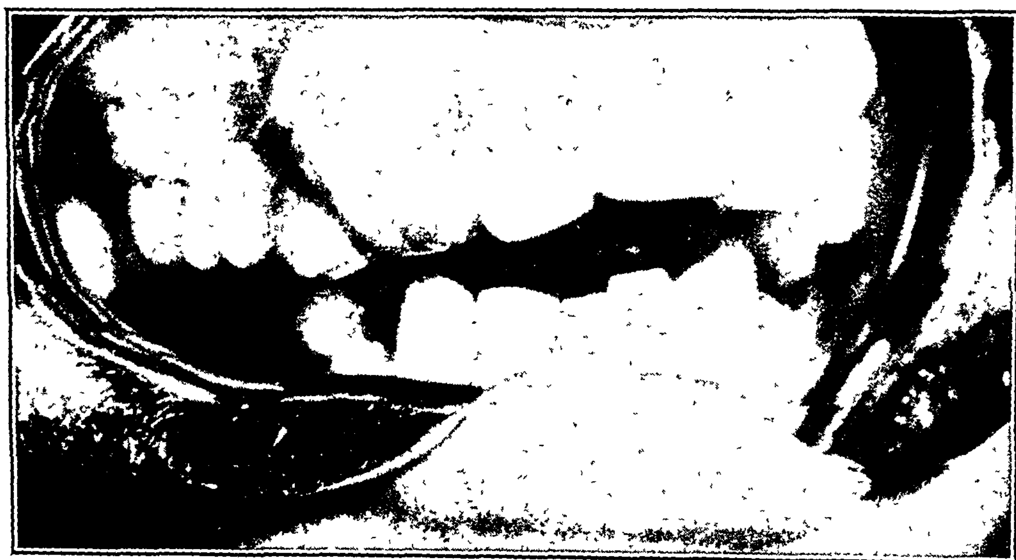


FIG. 113. Pyogenic granuloma (epulis)

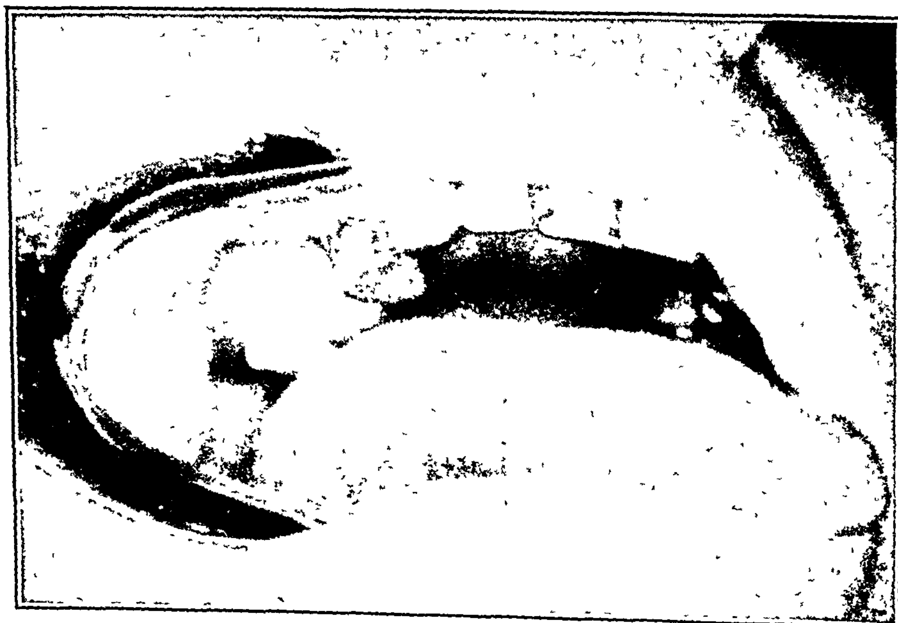


FIG. 114. Leukoplakia.



FIG 111 Scar tissue growths due to denture injury.

A B

FIG 112 Scheme for excision of A, Scar tissue growths, and B, flabby ridge.

tion, and malignant degeneration may result. Complete obliteration can be performed only by excision or roentgen therapy, but this is not indicated except for small localized lesions. If the biopsy report reveals carcinoma, the patient must be immediately referred to someone qualified to perform the necessary surgical or radiation therapy.

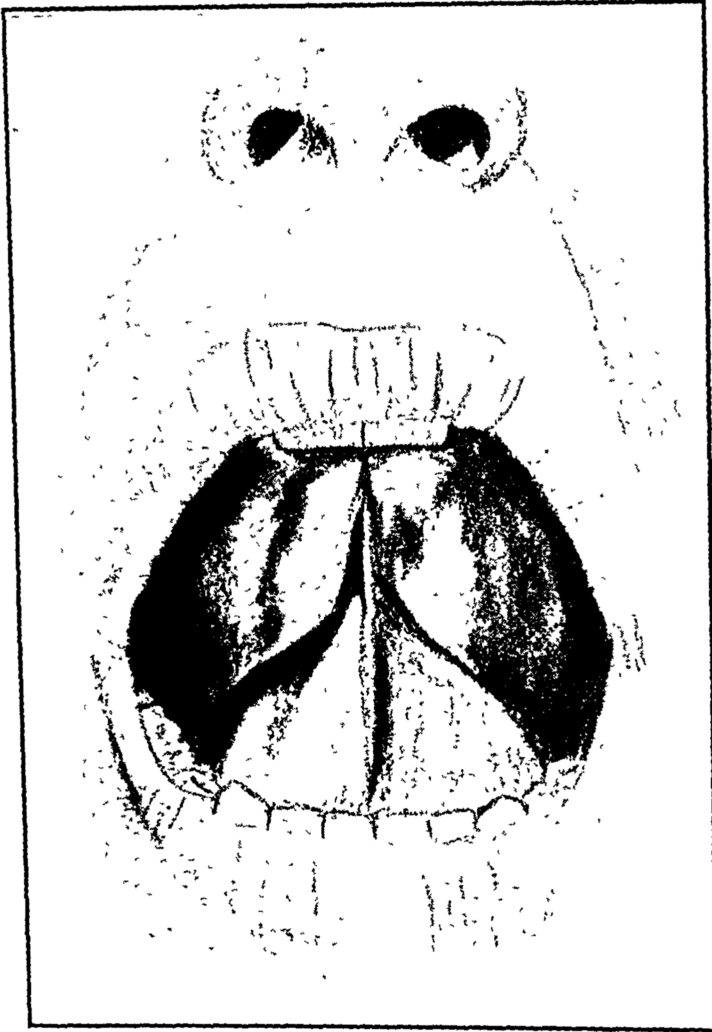


FIG 116. Ranula.

Two forms of *cysts of the soft tissues* may be encountered. The *mucocele*, usually located on the inner surface of the lip, presents as a soft, fluid filled, nontender sac which is loosely attached to the surrounding tissues except at the surface, where it may be adherent. Removal should be through an elliptical rather than a straight line incision to minimize the possibility of rupture before enucleation is complete. It is better to include some normal tissue with the sac for these cysts are very friable, and once the contents have escaped, dissection becomes much more difficult.

Surgical excision of the elongated folds of a denture injury tumor, flabby ridge, or flabby tuberosity, should be kept as simple as possible. The two incisions outlining an ellipse should be made so that the resulting defect is trough-shaped. The edges can usually be closed without undermining, thus keeping trauma to a minimum. It is important to leave all surfaces covered with mucosa and to this end multiple excisions, spaced one or two weeks apart will often change a complex problem into a series of simple ones.

One method of performing the more extensive procedure of deepening a labial sulcus is illustrated in Figure 84 A–G. Such operations offer a markedly improved ridge and sulcus but produce rather severe postoperative pain and swelling. There may be considerable bleeding due to the necessary amount of sharp dissection required to undermine the flap.



FIG 115. Mucocele. (Ormsby and Montgomery, *Diseases of the Skin*)

Pyogenic granuloma is seen very frequently in oral surgical practice. It is not a true tumor but rather an overgrowth of granulation tissue, usually arising from an area of infection. The substance is made up of a highly vascular connective tissue matrix containing large numbers of all types of inflammatory cells. Treatment is directed at removing the exuberant tissue and eliminating the dead bone or other foreign material which may be present.

Leukoplakia is a whitish thickening of the outer layer of the epithelium, presumably resulting from chronic irritation, and must be regarded as fertile soil for the development of cancer. The proper management of leukoplakia calls for elimination of tobacco in all forms as well as other irritants such as highly spiced foods. The patient should be recalled annually for observation so that any thickened, cracked, or ulcerated areas may be biopsied. Under no circumstances should irritants or caustics such as silver nitrate or phenol be applied, for these agents will not produce total destruc-

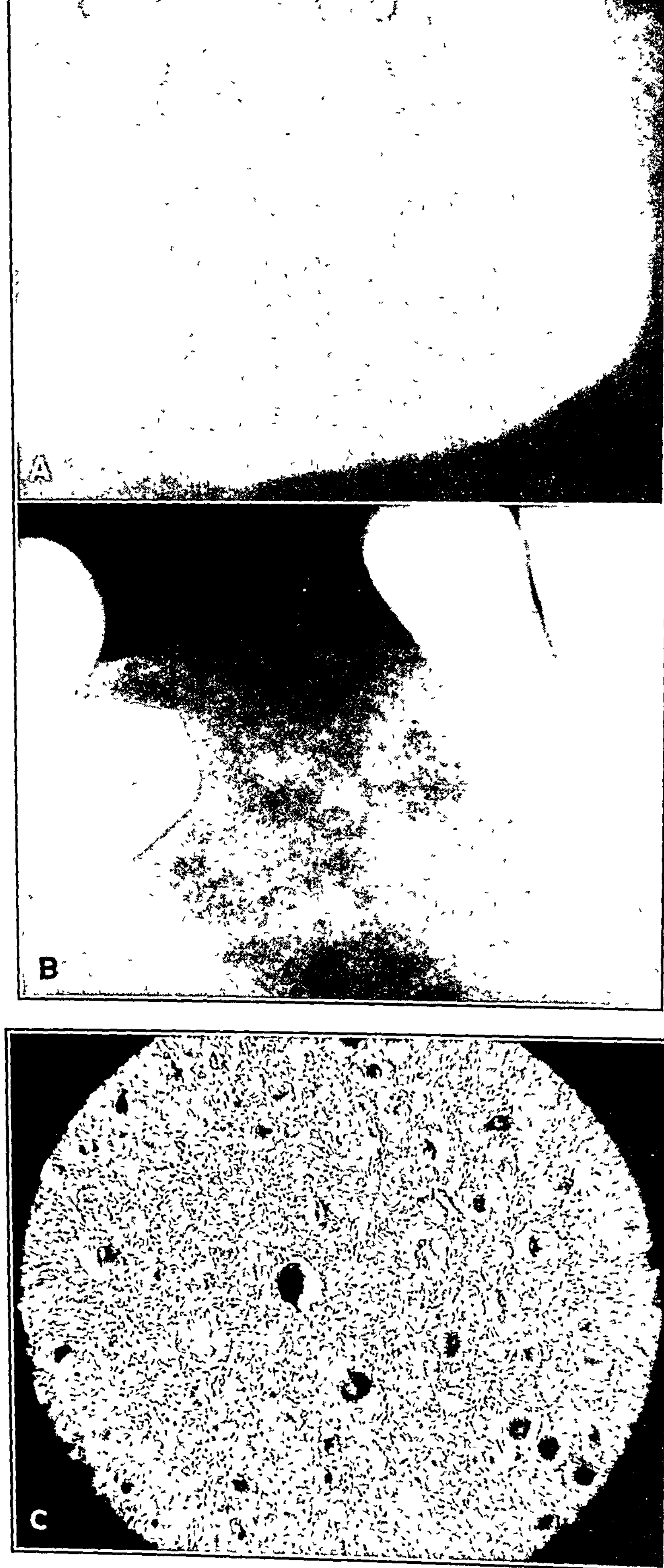


FIG. 117. Osteofibroma: *A*, Lateral jaw radiograph: *B*, dental radiograph, and *C*, microscopic appearance, 90 ×. Fibrous tissue and areas of bone deposition and destruction are seen (Case of Dr. J. C. Tam.)

Ranula, so-called because it resembles the undersurface of a frog, is a soft, fluid-filled swelling beneath the tongue, caused by obstruction of a duct of the sublingual or one of the minor salivary glands. The recommended treatment is marsupialization by removal of the exposed wall of the cyst, leaving that portion which is against the floor of the mouth to function as the new oral mucosa. The cyst lining should be sutured to the oral mucous membrane around the entire periphery. Traction sutures will help to keep the membranes taut while the stitches are being placed.

BENIGN TUMORS OF BONE

Osteoma and *osteochondroma* are uncommon. The pathological diagnosis is usually made microscopically upon examination of tissue which was presumed to be an exostosis or torus at the time of removal.

Central *osteofibroma* (ossifying fibroma), closely identified with fibrous dysplasia of bone, may involve the entire thickness of the mandible or maxilla. Total resection would be required to completely eliminate the tumor and this is not justified for benign lesions. In such a case partial removal may be done to reduce bulk and restore normal jaw contour as well as to reduce facial disfigurement.

Multiple *periapical fibromas* or *cementomas* are most frequently found on lower anterior teeth in females around the age of forty. There is a tendency for more frequent occurrence in the Negro race. Stafne feels that fibroma and cementoma are simply different phases of the same lesion. The fibroma, being a soft, uncalcified structure, is radiolucent, while the mature cementoma, being calcified, is radiopaque The tooth is characteristically vital and there are no symptoms. Extraction should not be performed and the lesion should be left undisturbed.[5]

Central giant cell tumor usually occurs during childhood or adolescence and is most commonly found in the lower bicuspid area. However, it may appear at any age and in any region of the upper or lower jaws. The question of etiology has drawn much interest from students of bone pathology, but the majority consider it a true tumor, of unknown cause. Although it is the consensus of most pathologists that the microscopic structure cannot be distinguished from that of the giant cell epulis, the pathogenesis of the two is entirely different. The central type may grow to considerale size without producing symptoms. The first sign may be a smooth swelling in the mucobuccal fold or a separation of the contacts of teeth which are displaced by the growth. Teeth may be devitalized and paresthesia of the lip may occur due to pressure destruction of nerves, although in the author's experience the inferior alveolar nerve can usually be saved at operation While a single tumor is the usual finding, multiple types are occasionally seen and a familial

considered, and Berger has reported cures in 4 cases treated solely by this conservative means.[8]

The *ameloblastoma* (adamantinoma) is sometimes grouped with the malignant growths because of its strong tendency to recurrence, although metastasis seldom if ever occurs. It is more frequently



FIG. 119. Central giant cell tumor of mandible (Case of Dr R H Linn.)

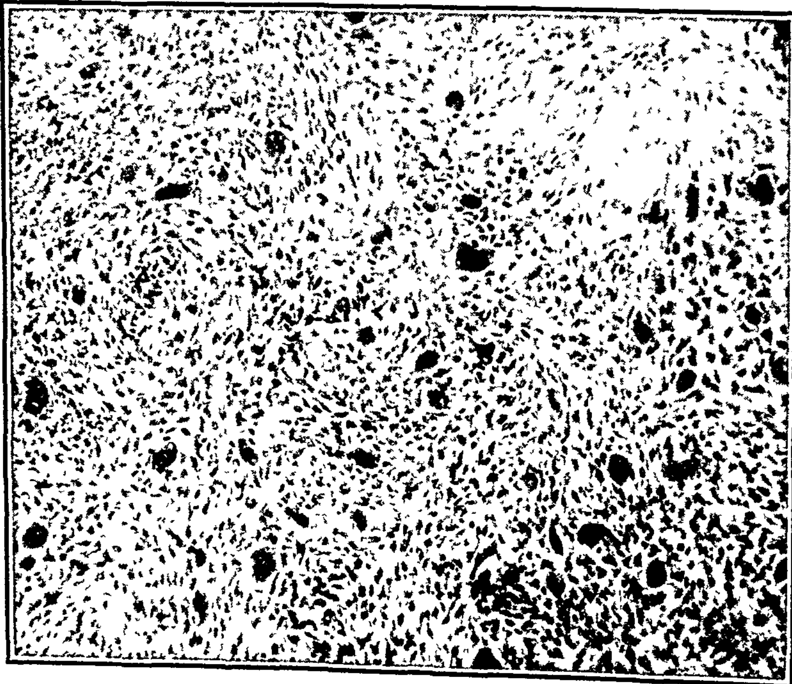


FIG. 120. Microscopic appearance of giant cell tumor, 85×.

association has been reported by Brannin and Christensen[6] and by Waldron.[7]

The radiographic appearance is often characteristic, revealing, on close examination, a scalloped effect on the periphery of the circular radiolucent shadow, which is caused by small penetrating lobules

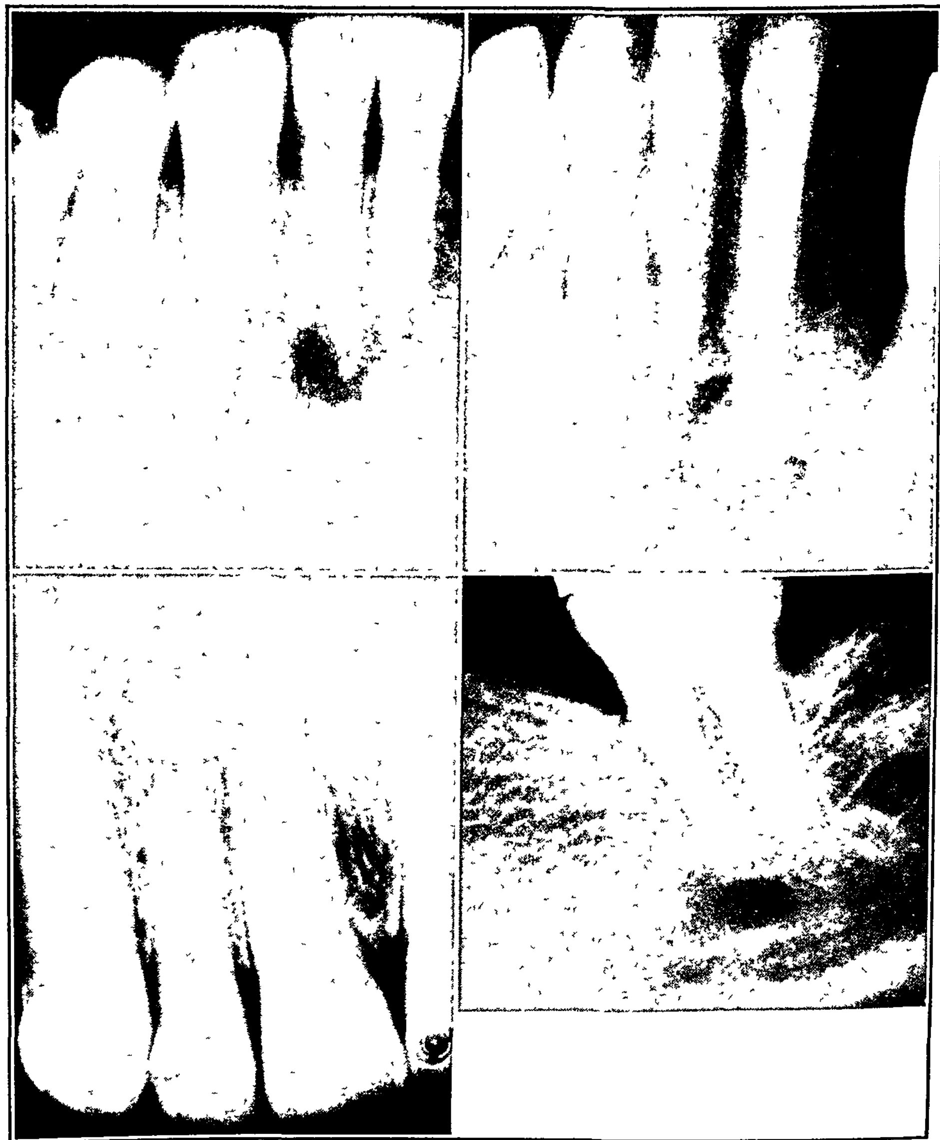


FIG 118 Periapical fibromas and cementomas (Courtesy Dr. John C Austin)

of the tumor. The "soap bubble" appearance is due to separation of individual lobes by bony or fibrous partitions. The principal *differential diagnosis* lies between ameloblastoma, a much rarer tumor, and some form of cyst of the jaws.

Treatment is by complete surgical removal, as described on page 175 in the chapter on technics, although roentgen therapy may be



Fig 122 Facial swelling due to ameloblastoma of mandible.



Fig 123 Ameloblastoma. Microscopic appearance, same case as Figure 122. 35×.

discussed with the benign jaw lesions because the differential diagnosis of any circular radiolucency must always include ameloblastoma, giant cell tumor, and cyst.

The dentist who is not specializing in oral surgery is unlikely to see more than a single case of this tumor in a lifetime of practice. The most frequent site is the molar or ramus region of the mandible. Several morphological types have been described. In general, those which are most cellular and least cystic are likely to be more dangerous. The characteristic cords of adamantine epithelium arranged in rosettes around stellate reticulum are occasionally found in the walls of dentigerous cysts. There is no uniform agreement among oral pathologists as to whether this justifies classification of such a cyst as a true ameloblastoma, since invasion of the surrounding bone by cords and lobules is not found with this type. As the best chance for cure lies in the first operation, the surgeon who attempts removal of an ameloblastoma should be well qualified to perform very thorough enucleation, excision, or bone resection, as may be indicated by the degree of invasion found at operation.

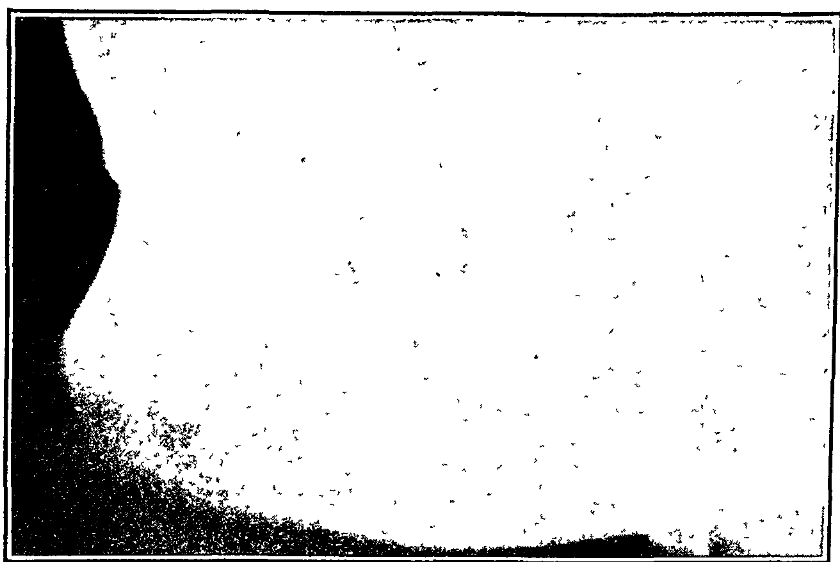


FIG 121 Ameloblastoma. (Courtesy Dr Leo G Rigler)

BENIGN TUMOR-LIKE CONDITIONS OF BONE

Every dentist should be thoroughly familiar with the various types of *cysts of the jaws*, for they occur quite commonly and may be the cause of much bone destruction or severe acute infection.

The *dental root cyst* (dental cyst, radicular cyst) forms about the apex of a tooth following death of the pulp. In its classical form the cyst is made up of a lining of stratified squamous epithelium surrounded by a fibrous wall or capsule. The epithelium is felt by Kronfeld to be derived from the epithelial rests left behind by

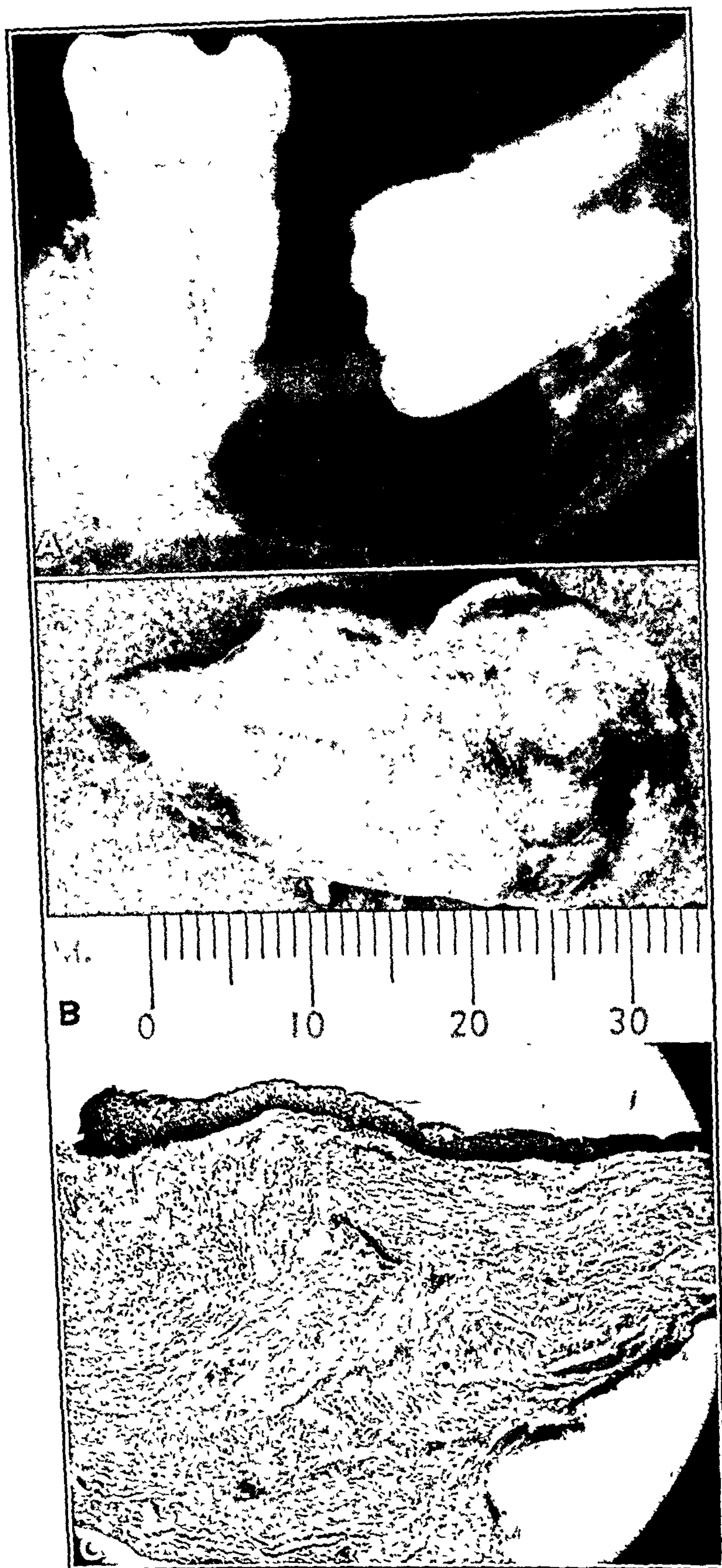


FIG 125. Dentigerous cyst: *A*, Preoperative radiograph; *B*, specimen, and *C*, photomicrograph of cyst wall. (Case of Dr D. E. Brannin, courtesy of J. Oklahoma Dent. Assn.)

Hertwig's sheath during formation of the root.[9] These rests proliferate in response to the stimulus of inflammation resulting from pulp infection. The interior of the cyst is filled with straw-colored, amber, or purulent fluid. The latter may become partially solidified, being then spoken of as "inspissated pus." The cyst contents, both fluid and dead epithelial cells, are derived from the lining membrane. Considerable cholesterol in the form of tiny crystals may be found in the lining and in the fluid. Cysts tend to con-

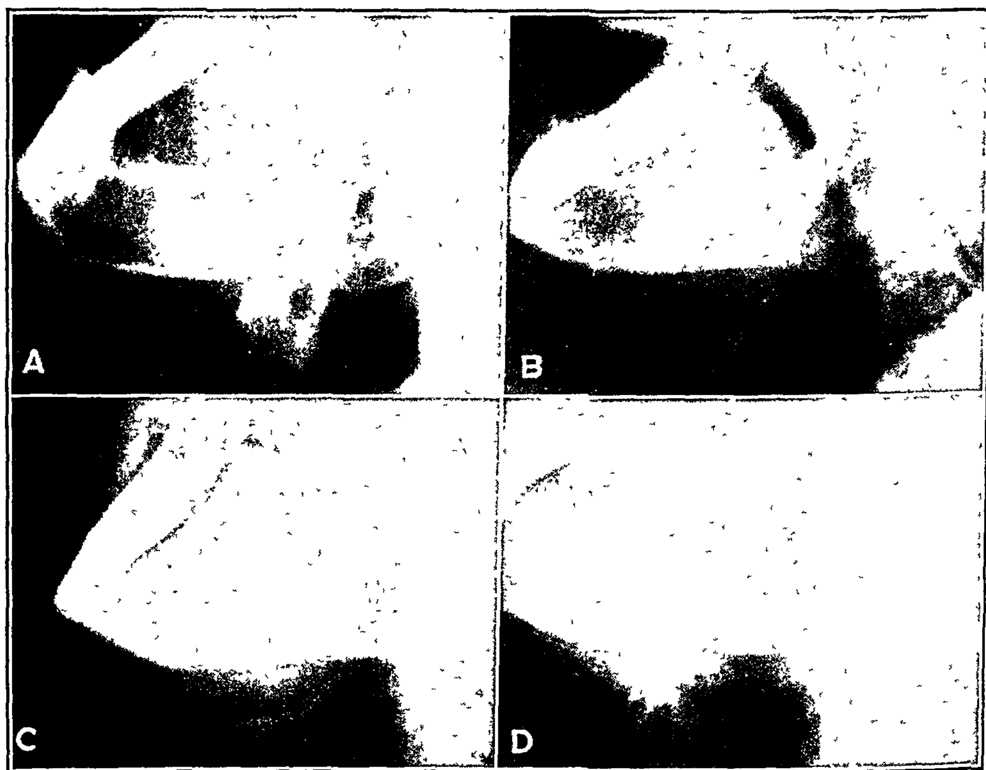


FIG 124. Dental root cyst Serial radiographs demonstrating bone regeneration after surgical removal *A*, Before operation, *B*, three months after removal, *C*, five months after removal, and *D*, nine months after removal (Clark and Holland, courtesy of J Oral Surg)

stantly increase in size, apparently due to a slight positive osmotic pressure within the sac. This may be deduced from the common observation, emphasized by Thomas, that cysts which are provided with constant drainage steadily reduce in size.[10]

A cyst enlarges at the expense of the bone within which it is developing. Although this bone resorption is slow, it can result in nearly total destruction of the upper or lower jaw. Thoma believes that as bone is destroyed by the cyst there is a compensatory strengthening of the remaining portion of the jaw, which would account for the relative infrequency with which spontaneous fracture occurs.[11]

bidity due to the large amount of material which is immediately available for bacterial growth, and the extensive area of tissues opened to such attack. Wide open drainage and intensive antibiotic therapy are urgently needed. The epithelial lining may be destroyed by the acute suppuration, so that only a fibrous wall will be seen on microscopic study.

The most curative method of *treatment* for a dental root cyst includes removal of the entire sac, epithelial lining, and liquid contents (see p. 175) together with the offending tooth and any other teeth which are nonvital or would be devitalized by the operation for enucleation. The wound is either closed, in an effort to secure primary healing, or may be dressed open with medicated gauze which is changed about every four days, to permit healing by granulation.

The many *variations of treatment measures* that have been suggested are directed toward conservation of teeth, minimizing the severity of the operation, or preventing the development of a fistula into the nose or antrum. The most conservative of these is the *Partsch operation* (p. 177). Another method is to remove the lining and perform root canal therapy on any teeth whose apices are denuded by enucleation of the cyst wall. However, any compromise method of management carries the risk of a less certain result, and the decision must often be left to the patient after the several alternate methods of management have been explained.

Dentigerous cysts are so named because a tooth is always present in the wall, usually with the crown lying in the interior of the cavity. In the strict sense a dentigerous cyst is one type of follicular cyst; lateral types and other forms are occasionally seen.

Since these cysts are invariably associated with an unerupted tooth it would be expected that they should be most common in those areas where impaction is most frequent, and this is the case. They are found most often in the third molar, cuspid, and bicuspid areas, in that order of frequency.

Treatment is the same as for dental root cysts, except for the question of management of the unerupted tooth. If there is no possibility that the tooth could erupt and become a useful member of the dentition it should be removed. On the other hand, in young subjects, a cuspid or bicuspid should be given every chance to erupt. The Partsch procedure, and some provision for maintaining the space in the dental arch comprise the essence of this method of management.

A *residual* or *indeterminate type* cyst is one which lies in an edentulous area, so that the exact etiology cannot be established. Most of these are probably dental root cysts which remained after extraction of the causative tooth. Treatment is the same as for the dental or dentigerous type.

Nasopalatine cysts form from remnants of the nasopalatine ducts which usually are obliterated shortly after birth. It is difficult to differentiate radiographically a small nasopalatine cyst from a large

In size, cysts vary from a few millimeters to many centimeters in diameter. Many small periapical lesions which are removed along with an extracted tooth are in reality true cysts, with an epithelial lining, although they appear to be granulomas on superficial gross examination.



FIG. 126 Nasopalatine cyst *A*, Preoperative appearance; *B*, eleven weeks after removal. (Case of Dr J C Tam, courtesy of Jour. Am Dent Assn)

Unless they produce visible expansion of the jaw, large dental root cysts usually remain asymptomatic until pathogenic organisms are introduced through an extraction wound or by way of the blood stream. Acute infection of a large cyst may produce severe mor-

they are usually asymptomatic, the author has seen one develop an acute pyogenic infection, presumably of hematogenous origin.

Anomalies and Odontomes. Although of academic interest to oral pathologists, these objects may be resolved, for surgical purposes, into a single group which have the common factor that they are calcified, purposeless objects which may require removal for any of several reasons, the chief one being the possibility of their predisposing to acute infection.

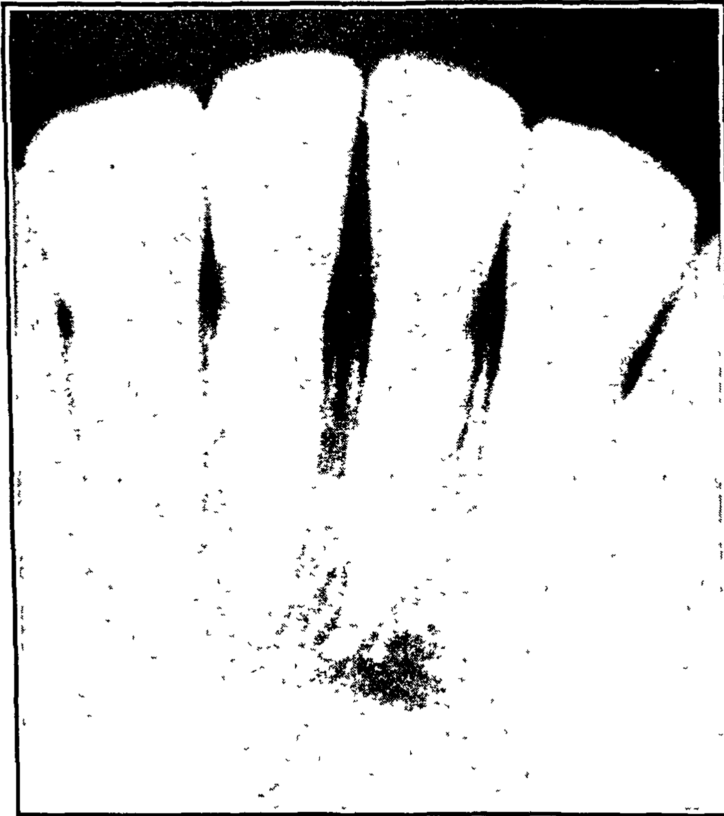


FIG 128. Traumatic cyst (Case of Dr. P E Jurgens)

Fusion, gemination, dilaceration, dens in dente, and dysplasia of any of the components of the tooth germ represent malformations that will frequently result in pulpitis or a pericoronitis type of infection.

The hard odontomes, sometimes classified as true tumors, are included here with the anomalies since the indications for and method of removal are similar. The *compound odontome* or anomaly is made up of multiple tiny calcified objects resembling malformed teeth. This type is often enclosed in a well-developed capsule and hence is relatively easy to remove. The *complex odontome* or anomaly consists of a conglomerate mass of cementum, dentin, and enamel, which is usually fused to the surrounding bone so that removal is extremely difficult. Mixed types of odontomes occur, and for pur-

incisive foramen. For this reason, surgery should be limited to those cases where swelling or drainage is present, and to those of large size. Enucleation should be performed through the palatal approach by means of the same type of flap that is used for impacted upper cuspids. The adjoining teeth are vital in all cases of fissural or developmental cysts unless intercurrent dental disease has produced death of the pulp coincidentally.

The most common variety of *fissural cyst* is the *median palatine* or *midline* type, which forms in the hard palate from epithelial islands remaining from embryonic life. Another variety is the globulomaxillary, which forms between the cuspid and lateral incisor.

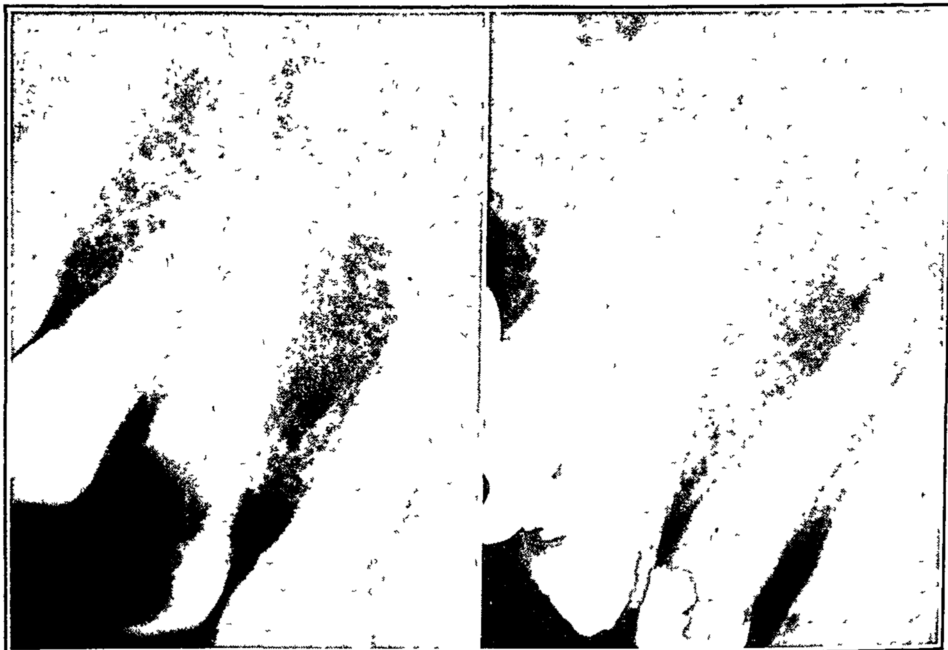


FIG. 127 Globulomaxillary cysts Note divergence of roots

Both nasopalatine and median palatine cysts may produce a swelling on the palatal surface or there may be a sinus which intermittently discharges pus.

Thoma has called attention to the *traumatic* or *hemorrhagic cyst,* usually occurring in the mandible, and found principally in young individuals who have sustained a severe blow some time previously. No epithelial lining is found although granulation tissue may be present. Simply opening the cavity and gently curetting will usually result in bony regeneration. The condition is so rare as to be virtually a pathological curiosity.[12]

Rushton has reported *solitary bone cysts* of the angle of the mandible. There is no certain explanation for their etiology. They are thought to be uncalcified islands of bony tissue locked off at the time of formation of the mandible in embryonic life.[13] Although

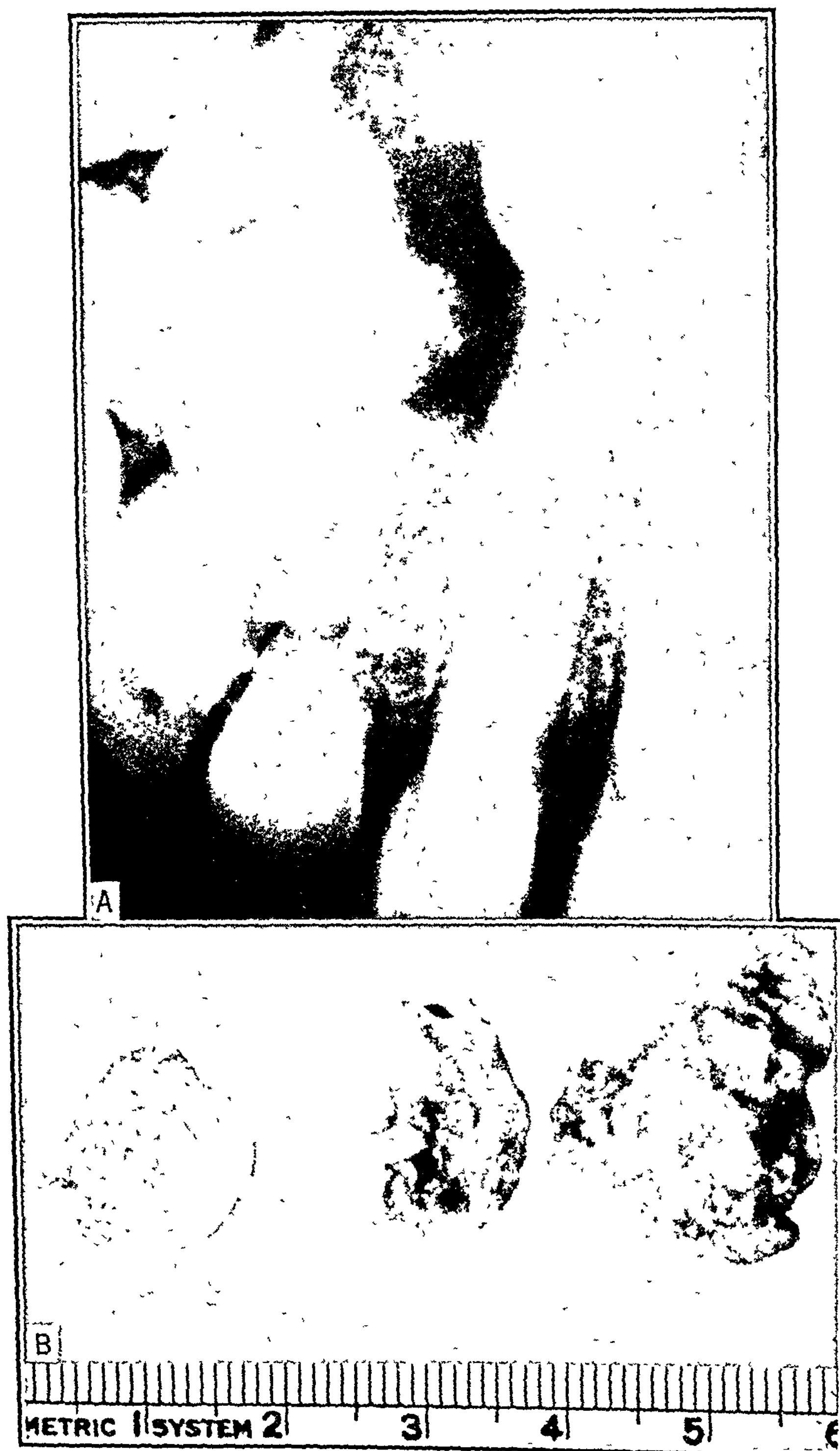


FIG 131 Complex odontome. *A*, Preoperative radiographic appearance; *B*, specimen. (Case of Dr. P. E Jurgens.)

poses of appraisal as to surgical difficulty they should be considered as if they were the complex type.

Removal of the protruding bony prominences of *torus palatinus*, *torus mandibularis*, and the other *exostoses* such as the buccal and labial type is performed by bone cutting instruments after the raising of an ample mucoperiosteal flap, in the manner which was described on page 174.

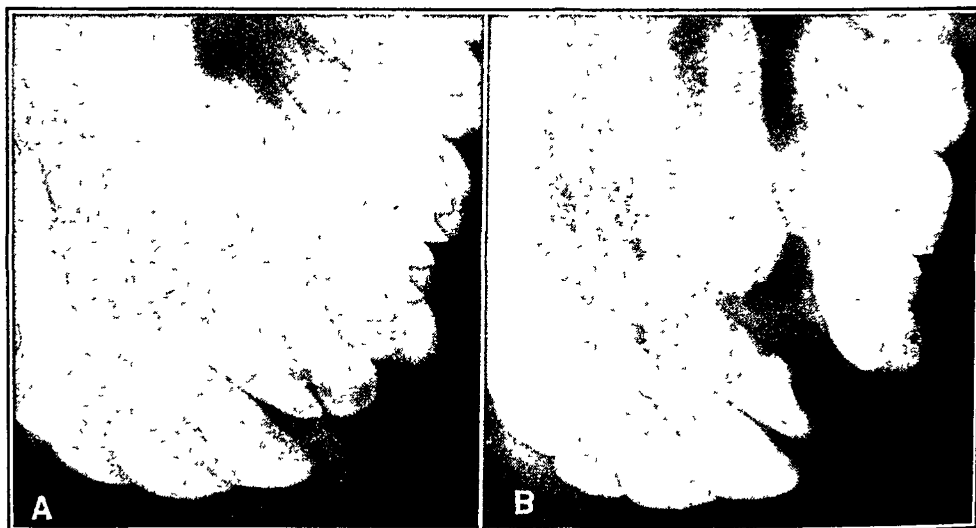


FIG 129. Compound odontome. *A*, Before, and *B*, after removal.

FIG. 130. Compound odontome Specimen of case shown in Figure 129.

secure tissue for pathological examination. *Monostotic* and *polyostotic* forms of this disease are recognized. Weinmann and Sicher feel it is synonomous with von Recklinghausen's disease of bones, in which a tumor of the parathyroid gland is always present.[14] (See Parathyroids, p. 52).

Fig. 134. Paget's disease of the mandible. The condition is seen more frequently in the upper jaw (Clark and Holte, courtesy of North-West Dent.)

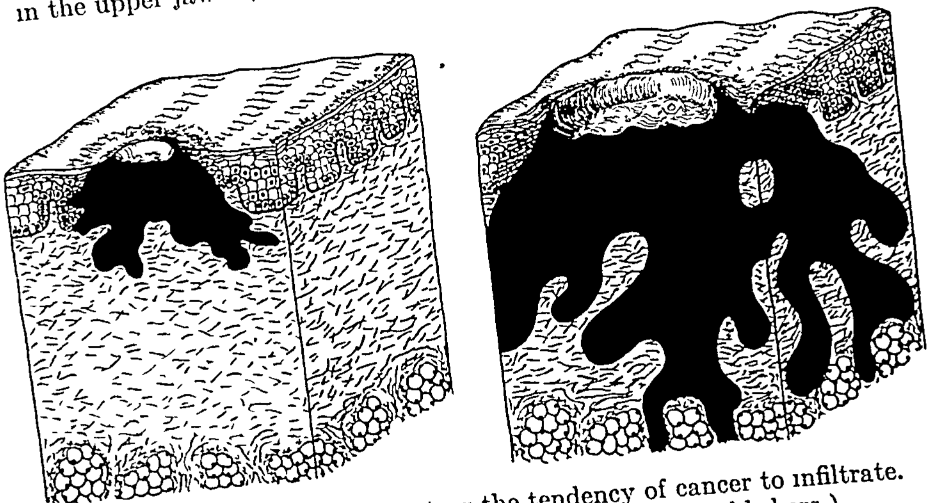


Fig 135 Diagram illustrating the tendency of cancer to infiltrate. (Sarnat and Schour, courtesy of Year Book Publishers.)

The massive enlargements of *Paget's disease* may be reduced in bulk in the same manner. Lesions of this or any other bone disease with changes elsewhere in the skeleton obviously will not be cured by removal of the intra-oral lesion, but such may be indicated for purposes of diagnosis, or for the relief of local symptoms.

Exploration of the intra-osseous soft lesions of *osteitis fibrosa cystica* associated with hyperparathyroidism is often performed to



FIG. 132. Buccal exostoses

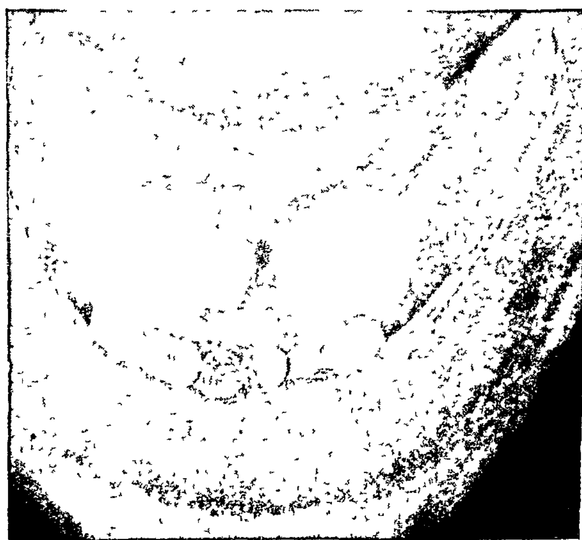


FIG 133 Torus mandibularis
(Burket, *Oral Medicine*, courtesy of J. B Lippincott Co.)

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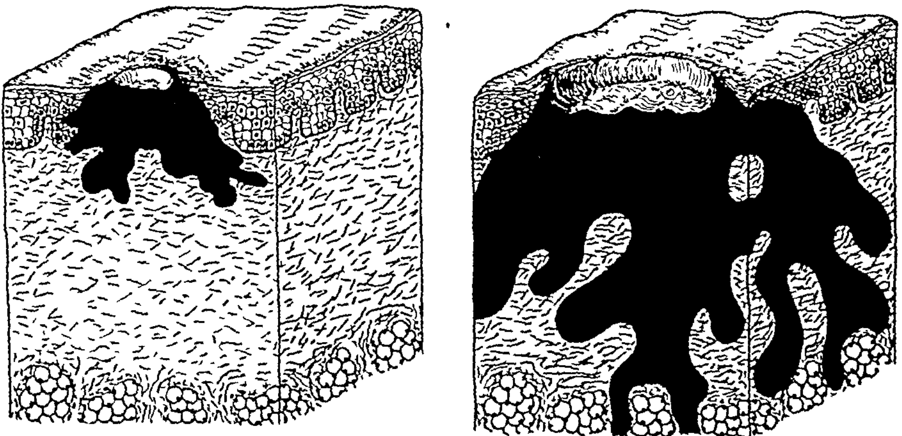


Fig. 135 Diagram illustrating the tendency of cancer to infiltrate. (Sarnat and Schour, courtesy of Year Book Publishers.)

Intra-osseous biopsy, with or without extensive curettage, is occasionally performed for eosinophilic granuloma and the other rare *abnormalities of lipoid metabolism* which occasionally affect the jaw bones. In all such cases the oral surgical procedure offers little hope for improvement, even in the local condition, due to the systemic nature of the disease.

MALIGNANT TUMORS

Role of the Dentist

The part played by the dentist in any case of malignant tumor of the oral cavity is usually that of diagnostician only, but he should assume that task willingly, for by so doing he is accepting one of the



Fig. 136 Photomicrograph of early carcinoma Note cords of cells breaking through basement membrane (Bell's *Textbook of Pathology*)

few opportunities that will come to him to save human life. The treatment of known cancer is not part of the practice of general dentistry. Many skilled oral surgeons immediately refer all these patients, rich and poor alike, to some center such as a cancer institute of a large teaching hospital, as soon as the diagnosis is made. Here the patient receives the greatest possible chance to live out his life expectancy, since large numbers of similar cases are being treated, and the individual profits by the accumulated experience of the institution. All experts are available—roentgenologist, nuclear

physicist, general surgeon, regional surgical specialist, oral surgeon, internist, dermatologist, etc. Many large private medical clinics also render excellent care for these patients. A weekly tumor conference or board is held at all teaching medical centers, where each case is carefully discussed before treatment is instituted.



Fig. 137. Carcinoma of tongue Note ulceration and raised border.



Fig. 138 Carcinoma of lower lip.

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FIG. 139 Carcinoma of gingiva

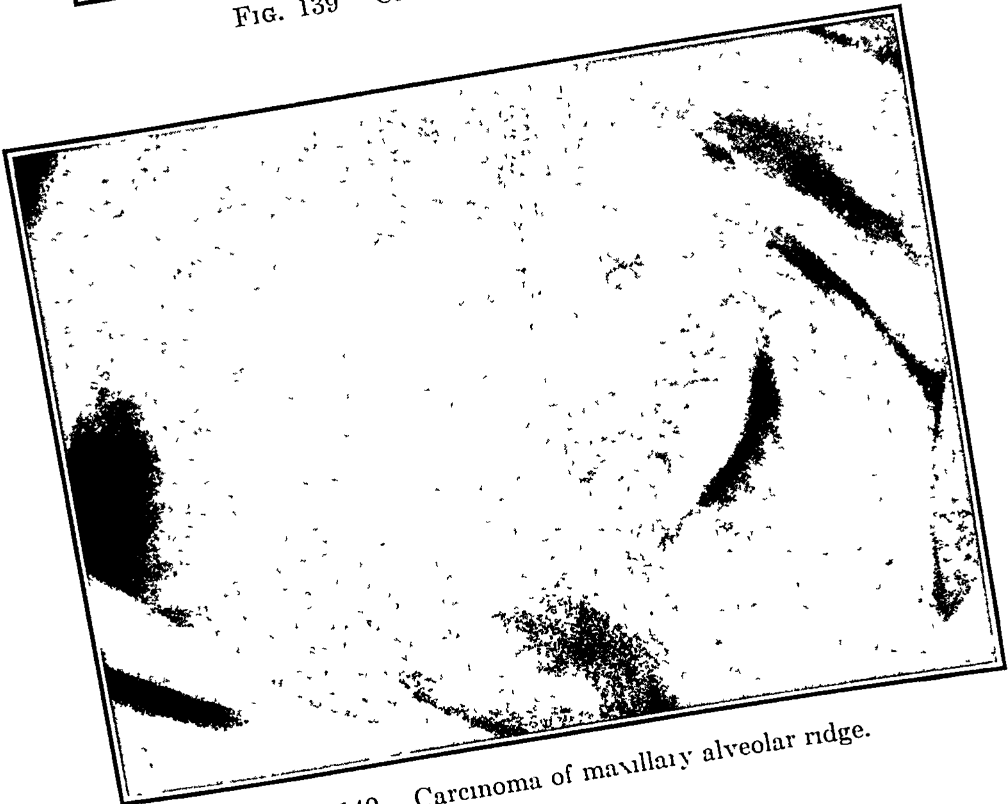


FIG 140 Carcinoma of maxillary alveolar ridge.

Early cancer is *curable.* Every malignant lesion begins with a nest of a few cells, and at this stage could be cured by simple excision. Unfortunately the symptoms of pain or bleeding, which would require the patient to seek medical or dental aid, occur late in the disease, and few cancers come to treatment in the early stages.

Regarding the dentist's role in making the diagnosis of cancer, Martin states, "Members of the dental profession hold a position of unique advantage with regard to the early diagnosis of cancer of the oral cavity and the prophylaxis against this disease. Malignant tumors of the mouth occur commonly in persons who otherwise apparently enjoy perfect health. Many of them have seldom, if ever, needed to consult a physician, at least not for any complaint that would require a thorough examination of the oral cavity. The medical profession is powerless to provide early diagnosis and prophylaxis for this group of people. On the other hand, since it is becoming an increasingly widespread practice, from childhood on, to have a thorough dental examination once or twice a year, the dentist can examine the oral cavity periodically under the most desirable conditions."[15]

Physical Findings in Carcinoma

Most of these lesions originate on the surface and are visible and palpable. One therefore looks for any ulceration or lump on the mucous membrane. The ulcer of carcinoma is characteristically heaped up at the edge, like a bomb crater, and usually has a necrotic center. This is explained by the fast growth or cellular activity of the border, there are too many cells, so they extend outward from the surface. Like a grass fire that becomes burned out in the center, necrosis remains after the tumor has advanced outward in a spreading fashion. These tumors are usually infected, so the presence of pus by no means rules out malignancy. The *hardness* to touch is highly characteristic, and approaches the feel of cartilage in consistency. This may be explained by recalling that squamous cell lesions are an overgrowth of the tough, almost hard surface cells of the epithelium.

Duties of the Dentist

The duties of the dentist who encounters a possibly malignant lesion are three: 1. Suspect. 2. Biopsy. 3. Refer.

One of the ways in which the dentist may enter into the *care* of the patient with oral cancer occurs when radiation therapy is to be used for any lesion about the jaws, and the teeth cannot be shielded. Complete removal of all teeth, good and bad, should be done so that radiation necrosis will not develop at a later date. Decisions regarding extractions for oral cancer patients should always be made in conjunction with the physician in charge of the patient.

Types of Oral Cancer

Squamous cell carcinoma (epidermoid) outnumbers all other forms in adults by a wide margin. The most common site is the lower lip



Fig. 139. Carcinoma of gingiva.



Fig 140. Carcinoma of maxillary alveolar ridge.

of adult males. Cancer of the mouth is 12 to 15 times as frequent in men as in women.[16] Sarcoma, malignant lymphoma (lymphosarcoma, leukemia, and Hodgkin's disease), and malignant melanoma are occasionally seen. At least 50 per cent of oral carcinomas arise in areas of leukoplakia. In children sarcoma is the more common malignant tumor.

The relative degree of malignancy is of great importance in planning treatment, but it is better for the dentist not to discuss percentage chances for cure or probable methods of treatment with the patient, as these matters are the concern of the medical personnel actually rendering the care.



FIG 141 Carcinoma of cheek.

It is customary to consider carcinoma of the oral cavity from the point of view of location, since there is some correlation with the degree of malignancy and curability. Martin gives the following percentages of five-year-cures for carcinoma in the various locations, as determined at Memorial Hospital, New York.

Location of Lesion	*Per Cent of Five-Year-Cures*
Lip	67
Tongue	30
Floor of mouth	19
Mucosa of cheek	24
Palate (hard and soft)	30
Gums	32
Tonsil	20

The percentage is considerably higher if the lesion is less than 2 centimeters in diameter when treatment is begun.[17] A generalization may be made that the more readily accessible to discovery and treatment, the better the prognosis.

Treatment

Treatment methods for oral cancer vary considerably in different parts of the world and in different sections of this country. In some Scandinavian countries irradiation is used almost exclusively and the statistical results are good. In this country surgery and radiation are often combined. The usual custom is to have definite criteria which determine whether treatment will be curative or palliative, and whether surgery, radiation, or both will be used.

Since squamous cell carcinoma nearly always metastasizes to the regional lymph nodes, these structures play an important part in the course of the disease. By serving as catch basins for migrating tumor cells they provide a certain measure of defense against widespread extension, although they eventually become secondary sites for further spread of the disease. One common plan for treatment of lip cancer is to first destroy the primary lesion, either with surgery or radiation, but to leave the lymph nodes undisturbed if none can be palpated. Repeated palpation of the cervical nodes is done every few weeks or months for an extended period, and if any detectable nodes are found, radical neck dissection is done. If, on the other hand, palpable nodes were present at the time of removal of the primary growth, a period of about three weeks is allowed to pass to permit any cancer cells which were in transit to reach the lymph nodes. Radical neck dissection is then done, for removal of all lymph nodes in the area of drainage of the primary growth, together with certain other structures. All cancer patients are kept on a perpetual follow-up schedule so that any recurrence may be caught at the earliest possible date.

Osteoradionecrosis

The principal complication that may be encountered in the treatment of oral cancer which is of dental interest is osteoradionecrosis. Although osteomyelitis which has developed in an otherwise normal mandible is a dreadful and serious disease, the morbidity, length of course, and mortality are far worse when the condition develops in a jaw which has received heavy radiation therapy. Such bone has greatly reduced circulation due to thrombosis of many of its vessels, is more sclerotic, and hence is able to put up only the feeblest defense against infection. To properly orient himself regarding this grave complication it is necessary for the dentist, who is traditionally dedicated to the conservation of teeth, to turn about in his thinking, and consider teeth as a menace to life itself.

Whenever the jaws are heavily irradiated for the destruction of cancer, the bone becomes severely altered for the remainder of the life of the individual. Many blood vessels are obliterated and the

resistance of the bone to infection becomes very low. At the same time it must be remembered that salivary gland function is sharply reduced or destroyed by irradiation and the dissolution of all remaining teeth by rampant caries follows as a matter of course. Putting it another way, a patient whose jaws are irradiated while teeth are still present is almost certainly doomed to osteoradionecrosis as a result of the entrance of infection through the dental pulp or the periodontium. The outcome of this drawn out, painful bone infection is often death.

Unfortunately authorities differ on the best course to follow in an effort to try to prevent this grave complication. Martin, in his monograph "Mouth Cancer and the Dentist," discusses the problem thoroughly, then concludes that it is probably best to grind teeth down flush with the gum and leave them in place as plugs.[18] Sarnat and Schour feel that the danger is minimized if teeth are extracted seven to ten days prior to the first radiation treatment.[19] Cook reviewed many cases and concluded that all teeth in the path of radiation should be extracted and the mucosal wounds healed before radiation is begun.[20] The trouble is that most radiologists wish to begin roentgen therapy on the day the diagnosis of cancer is made, if at all possible, so that the factor of time enters into the problem. In each case the dentist and radiologist should confer in an effort to work out the best possible solution. It is the author's feeling that the teeth should be extracted immediately and, whenever possible, radiation therapy deferred until after the mucosal wounds have begun to heal.

Terramycin was used by Winter and Van Gaasbeek to treat a case of radionecrosis of the mandible. After forty-five days of therapy consisting of 500 milligrams of the agent every six hours by mouth the oral mucosal ulcer had closed. Two months later there was no recurrence and bone regeneration was demonstrated by radiographic examination.[21]

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~ 10 ~

Deformities

CONGENITAL AND DEVELOPMENTAL DEFECTS

Abnormal Muscle Attachments

TONGUE TIE

When the lingual frenum is abnormally short or attached close to the tip of the tongue the patient may have difficulty in forming certain speech sounds or may bruise the frenum on the edges of the incisor teeth in attempting to protrude the tongue Treatment consists of incision or excision of the frenum. Bleeding can be kept to a minimum by crushing with a hemostat the tissues which are to be severed with the scalpel. Interrupted sutures should be placed to coapt the mucosal margins.

ABNORMAL LABIAL FRENUM ATTACHMENTS

In certain instances it may be necessary to incise or excise the upper labial frenum, and less commonly the lower. Promiscuous sectioning of this structure for all very young children whose upper incisor teeth are separated is unjustified in view of the findings of long term studies of this condition. As the permanent upper central incisors erupt and their alveolar process becomes longer the attachment of the frenum often rises proportionately. Eruption of the cuspids moves the lateral and central incisors medially, closing the diastema. On the other hand, the operation is a simple one and it is difficult to understand why so much importance is attached to it. Conceivably the upper lip might rise too high in smiling after injudicious sectioning or removal of the frenum, but it is quite evident that there are other factors besides the frenum involved in this function such as length and strength of the lip.

A simple and satisfactory operation is illustrated in Figure 143.

Hare Lip and Cleft Palate

INCIDENCE

While the frequency with which these deformities occur has been variously estimated at between 1 in 3000 and 1 in 2000 births, perhaps the best figures are those available from the state of Wisconsin, where a state law has required the reporting of every congenital deformity since 1917. For the year 1950, 111 such deformities were present in 82,000 births, a ratio of 1 in 770.[1] Of these, 88

had careful histories and 50 had a record of previous congenital defects in the family.

TYPES OF DEFORMITY

The Wisconsin figures reveal that in 1944 (a typical year) 20 newborn children exhibited cleft lip alone, 22 had cleft palate alone, and 36 had both defects, for a total of 78. The distribution of each

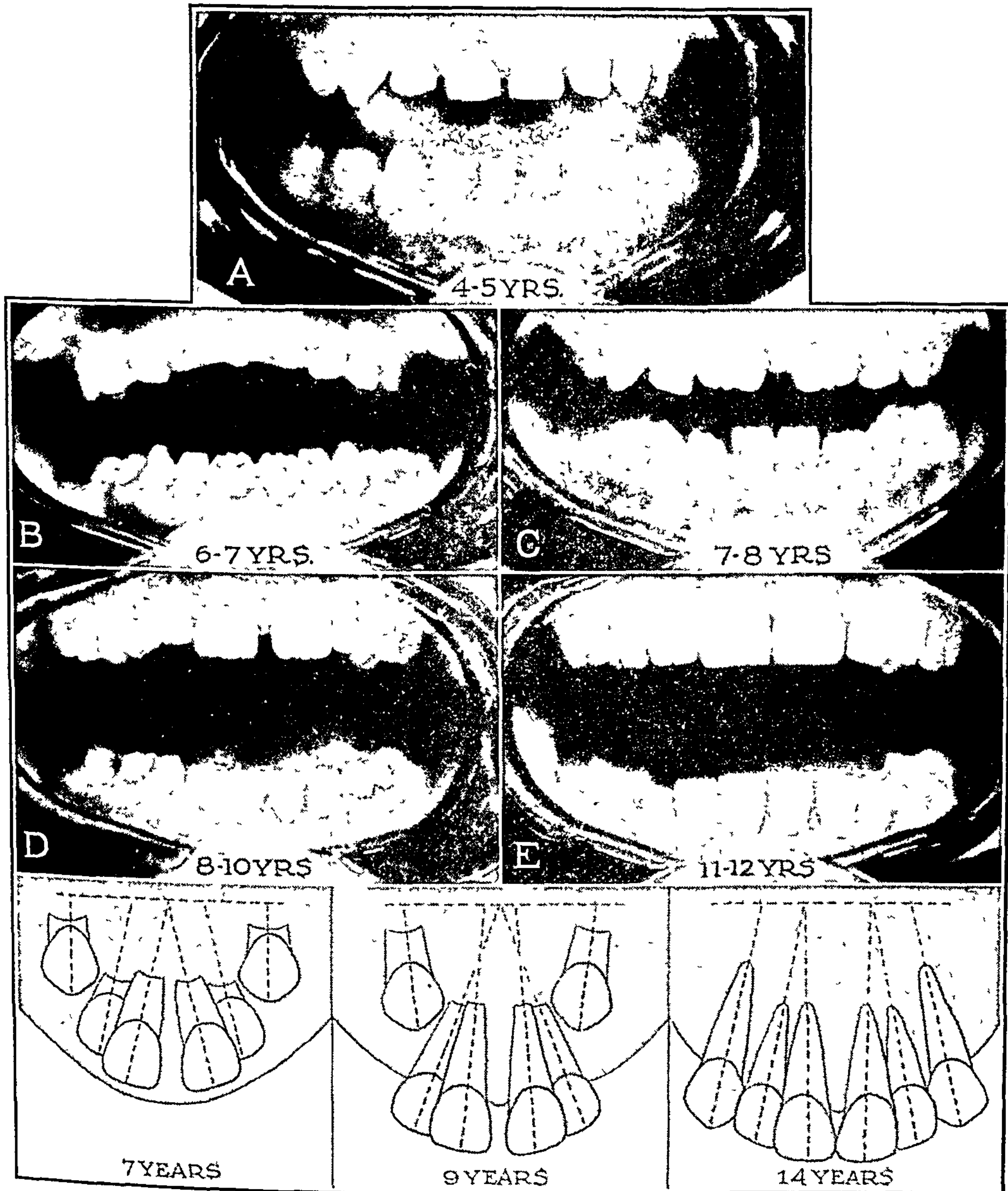


FIG. 142 The illustrations show how the physiologic space between the central incisors may close without surgery on the labial frenum (Massler and Schour, Atlas of the Month, courtesy of Am Dent Assn)

type of defect has been roughly the same over a period of years.[2] It may therefore be said that the chance for a child to be born with cleft lip alone or cleft palate alone is approximately equal, and the chance to be born with both is nearly twice as great as either one alone.

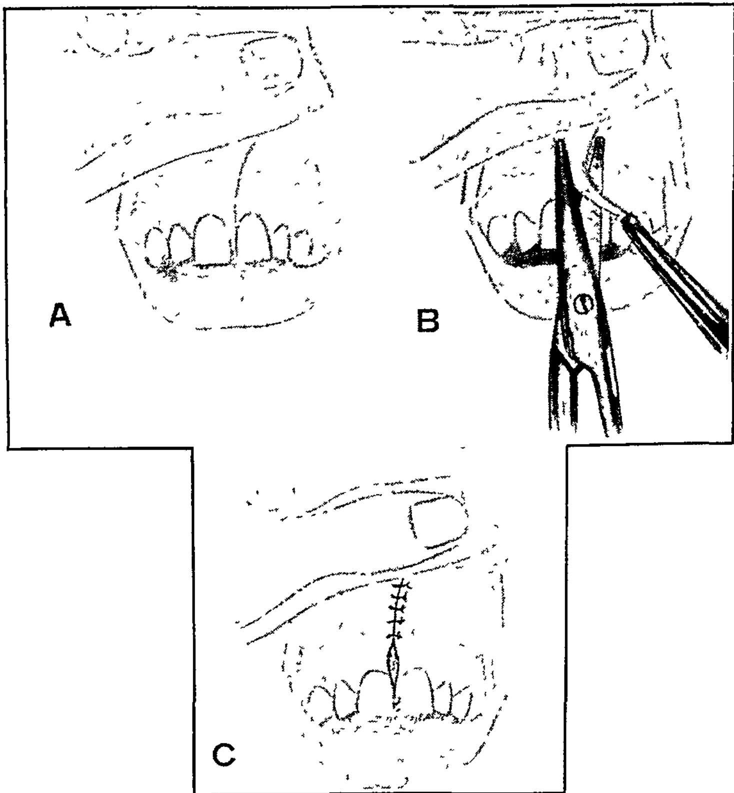


Fig 143 Operation for simple excision of frenum.

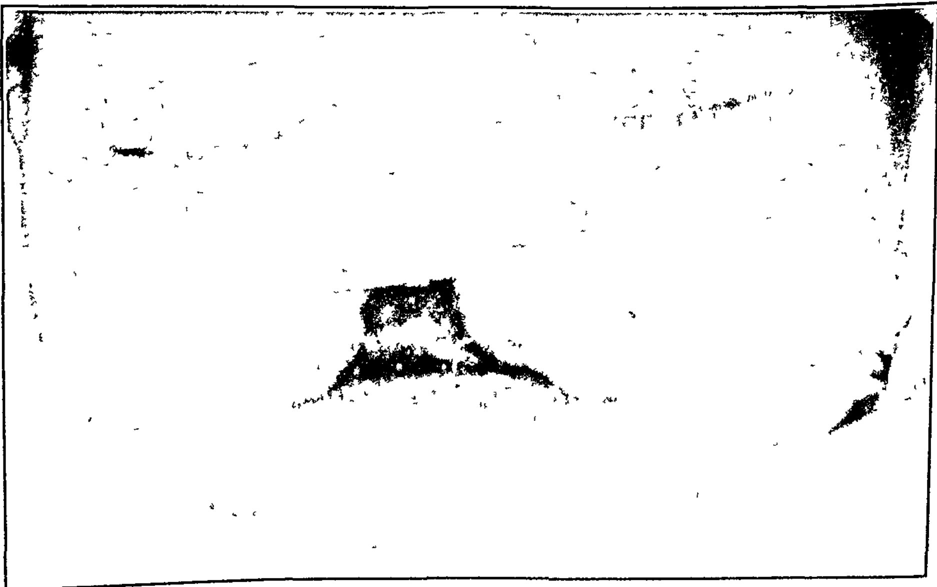


Fig 144. Unilateral harelip (Pruzansky, courtesy of Am J Orthodont.)

Authorities differ in their explanations of the way in which the defect develops in the embryo. Blair and Ivy[3] explain ordinary harelip by failure of the maxillary process to fuse with the globular process of the frontonasal process. Homans points out that "curiously enough, it is not usually between the maxillary process and the lateral nasal process that failure of union occurs, but between the lateral and medial nasal processes, so that the central part of the upper jaw, the premaxilla, which is left isolated by a bilateral

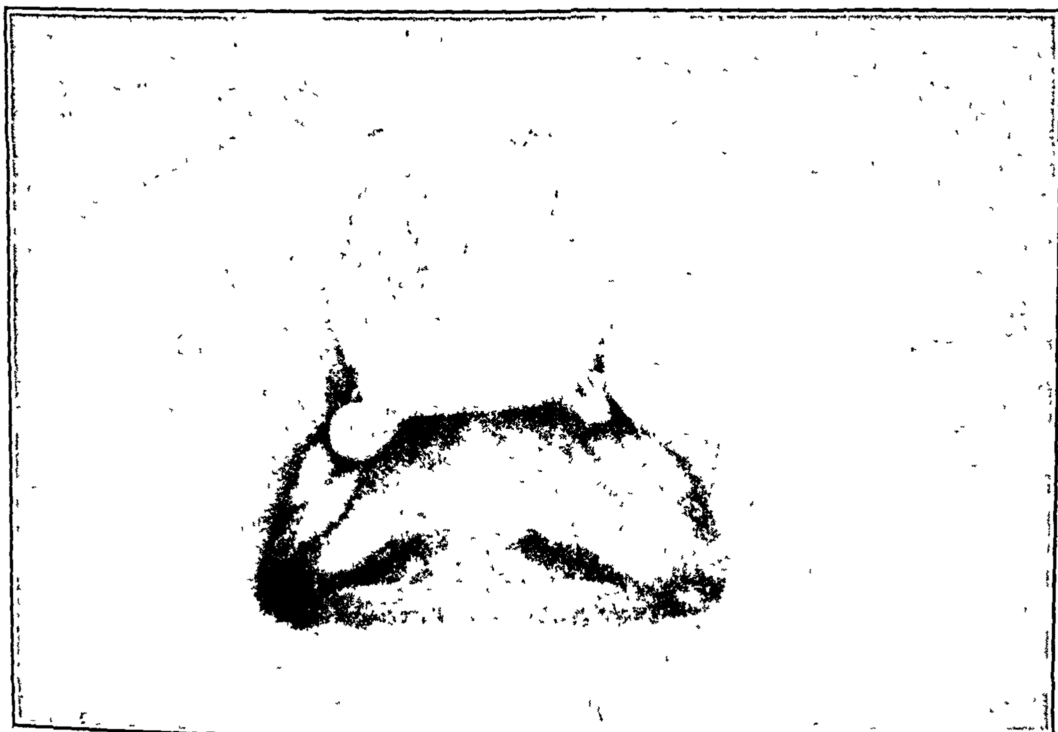


FIG 145. Bilateral harelip. (Pruzansky, courtesy of Am J. Orthodont)

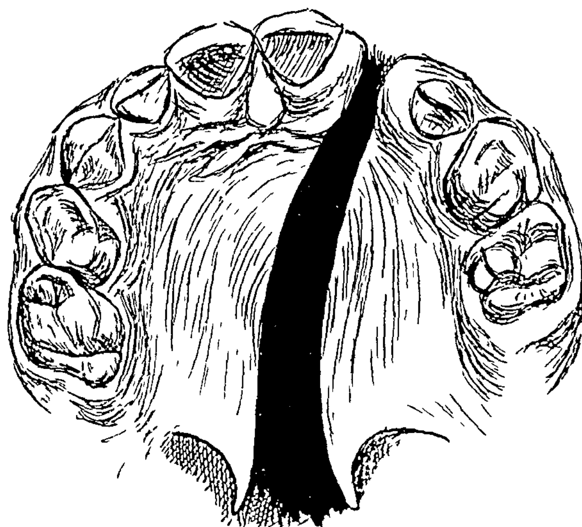


FIG 146. Unilateral cleft palate.

failure of fusion, commonly contains, not the four incisor teeth of the whole group of nasal processes, but only the two central incisors of the medial processes."[4]

Cleft palate or lip may be complete or partial. It is generally assumed that fusion proceeds from anterior to posterior, so that partial cleft palates usually have the opening at the rear. This would explain the presence of a normal lip accompanied by a cleft palate, but not the converse. Closure of the clefts is complete at the end of the twelfth fetal week, which points out the absurdity of the superstition that a "maternal impression" received late in pregnancy may cause this congenital defect.

Double harelip is fortunately less common than the single type. In either case the cleft is in the lateral incisor area as a rule, and this tooth may be malformed, missing, or there may be one or more supernumeraries.

SURGICAL TREATMENT

(*a*) *Closure of the Lip.* Virtually all authorities now agree that it is highly desirable to close the lip within the first forty-eight hours of life if the infant is in good condition. If this can be accomplished, feeding is facilitated, molding of the cleft alveolar process is begun early, and the morale of the parents is greatly improved.

Correction of the labial defect includes not only surgical uniting of all structures comprising the lip (oral mucosa, orbicularis oris muscle, and skin), but also rebuilding the floor of the nose, and moving the ala medially and upward. As in all procedures requiring the movement of parts to a new location, wide undermining is important. Of the many types of operations that have been described for the correction of hare lip that of Mirault has perhaps been the most popular. Many surgeons use some modification of the procedure as originally described. The principal feature is closure of the skin in a zig-zag line so that a straight vertical scar, with eventual contracture, is avoided.

(*b*) *Closure of the Palate.* While there is little disagreement among authorities about the proper time to close the lip, widely divergent views are held about the proper time for surgical correction of the cleft palate and the choice of operation for this purpose.

The basic objectives of cleft palate surgery are normal speech, anatomical separation of the oral and nasal cavities, and normal alignment and articulation of the teeth. It must, unfortunately, be observed that many patients have failed to achieve any of these goals in spite of many operations, 10 or 15 in some cases. Prior to the work of Brodie,[5] Slaughter, and others the controversy over time and type of operation was mainly between plastic surgeons, but now that the evidence of cephalometric and vital staining studies has become available, the orthodontic group has become prominent in the discussion.

Importance of Growth Centers. By injecting vital dyes into young monkeys at periodic intervals, then sacrificing them and making

sagittal and coronal sections, the location of the growth centers in the facial bones was determined. Serial cephalometric radiographic studies of human subjects revealed that the location and activity of these centers is much the same as in the laboratory animals. Tracings of head x-rays made of cleft palate patients who had been operated upon in infancy were compared with those of cleft palate patients who had not been surgically treated. A marked under-

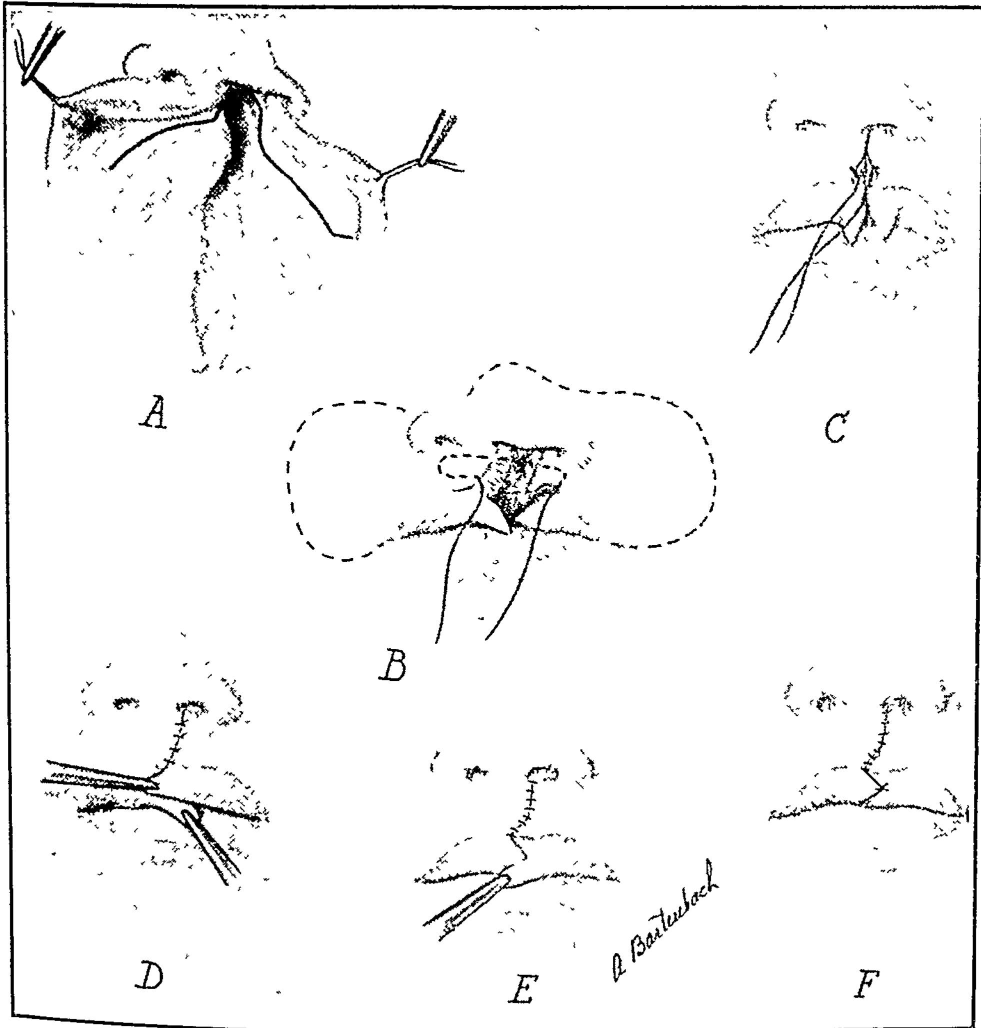


FIG 147. Mirault-Blair operation for harelip (Orr, Operations of General Surgery, courtesy of W B Saunders Company)

development of the treated maxillas was found, as compared to the group which had had no operation. Brodie and his co-workers concluded that surgery in the area of growth centers is responsible for underdevelopment, probably on the basis of interference with the blood supply.[6]

It must not be inferred from this work that all cleft palate surgery is bad. It is evident, however, that serious concern must be given to the time and location of surgical measures designed to

correct the defect, if the best interests of the patient are to be served. As a result of these studies many surgeons are now delaying palate repairs until development is complete or nearly complete. Operations that must be performed on infants are tending to avoid disturbances of areas of active growth centers. Activity in the field of obturator construction, once at a low ebb, is now being re-awakened.[7]

Operative Procedures. At the turn of the century the operation of *Brophy* was widely used. It achieved narrowing or closure of the cleft by molding of the maxilla and approximation of the two sides with transosseous silver wires.[8] Displacement of tooth buds occurred very frequently, so that they erupted in scattered locations all over the hard palate. Whether this was due to improper technic or to some inherent fault in the operation, it has largely been given up at the present time.

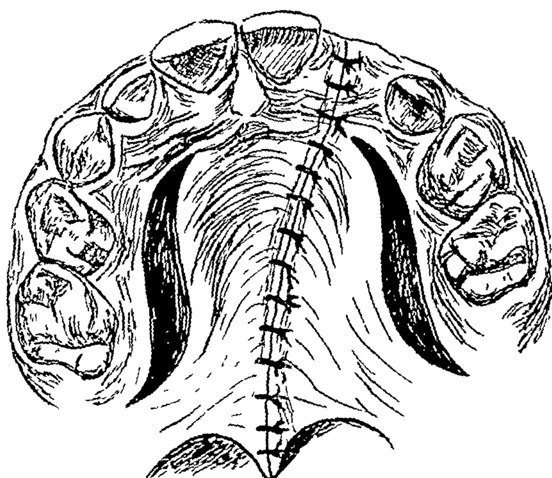


FIG 148 Von Langenbeck or Dieffenbach operation

A widely used method of closure is that of *Von Langenbeck* or *Dieffenbach,* which achieves approximation of the mucoperiosteal covering of the hard palate segments on each side by completely peeling them from their bony bed, and also making a longitudinal relaxing incision on each side, quite far laterally. The soft palate segments are approximated without tension by severing them from the posterior border of the hard palate and fracturing off the hamular process. The free median borders are surgically denuded of epithelium and joined with mattress and simple interrupted sutures. Even though successful closure of the cleft is achieved this method may leave the palate too short, so that apposition of the posterior border of the soft palate with the posterior pharyngeal wall is not possible during phonation.[9]

The *Dorrance "push-back"* operation is intended to provide adequate lengthening as well as closure of the palate by a two-stage operation. In the first stage all soft tissue is raised from the hard palate and the anterior palatine arteries are crushed, cut, and

ligated close to the bone. The hamular processes are fractured off with a chisel to relax the tensor palati muscles. When the surgery has been completed the detached tissue is receiving blood supply only from narrow pedicles in the right and left infratonsillar areas. The detached tissues are then put back in their original location

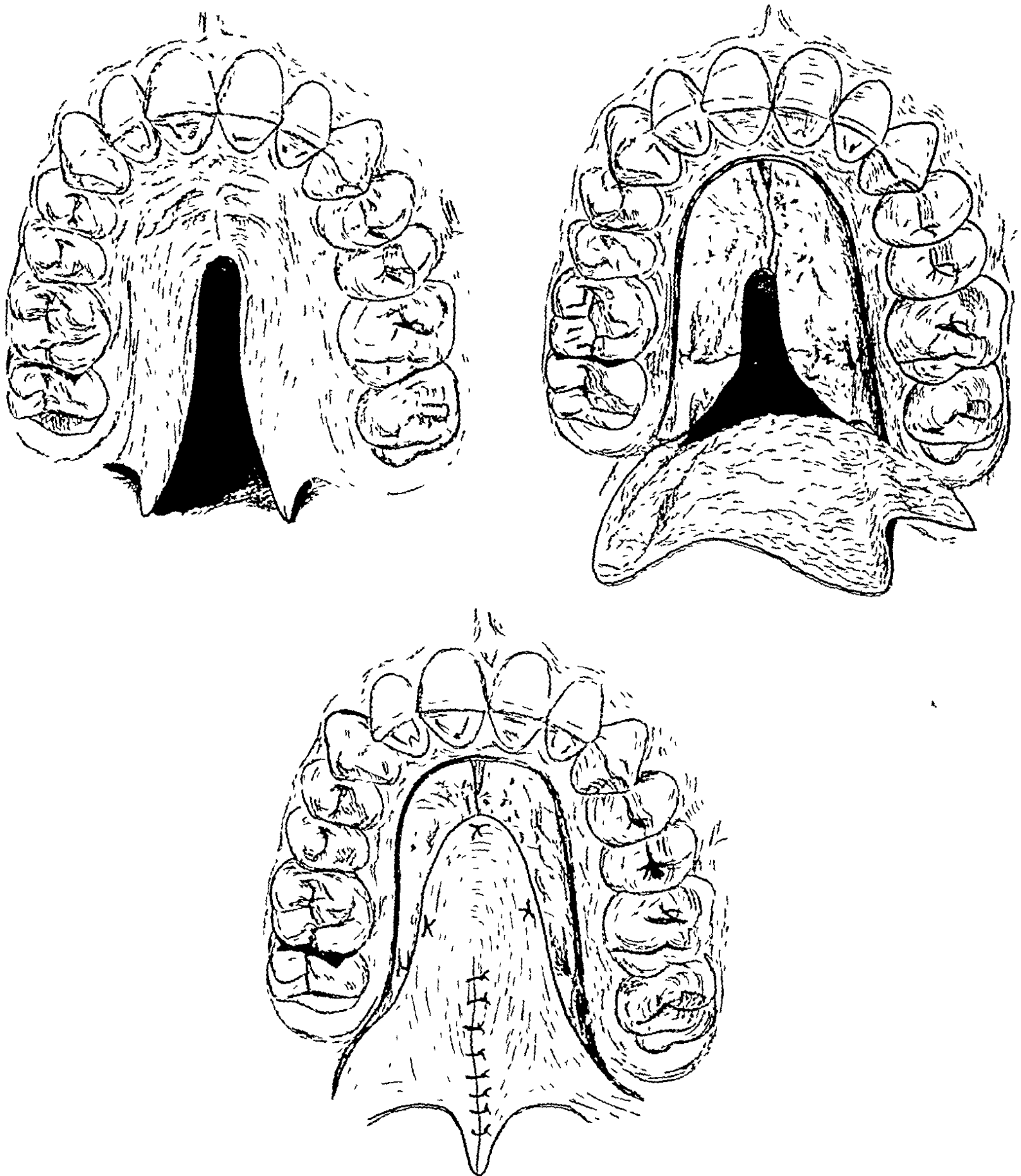


FIG. 149 Dorrance "pushback" operation: *A*, Preoperative appearance, *B*, mobilization of soft tissue covering hard palate during second stage, and *C*, final result.

and left there for two or three weeks so that collateral circulation may develop through the pedicles. This is the "delayed flap" principle used so frequently in plastic surgery. In the second stage operation all tissues are again detached as before, the free margins of the cleft are denuded of epithelium, and closure is achieved with

mattress sutures. The reconstructed palate is moved as far posteriorly as possible and the raw upper surface is secured to the vault by sutures and packing.[10] In Brown's modification of this principle the operation is performed in one stage, the anterior palatine vessels being drawn from their canals but not sectioned.[11]

Wardill performs a somewhat similar lengthening operation but provides an epithelial covering for the nasal surface of the new palate (which is not done in the Dorrance or Brown procedures) and in addition performs a pharyngoplasty to narrow the oropharynx.[12]

Dental Treatment

There is a strange irony in the fact that children with cleft palates, to whom teeth are so vitally necessary, usually receive substandard dental care and end up with broken down dentitions by the time they reach adult life. Many dentists are reluctant to do any dental work for them for fear of interfering with the plans of the plastic surgeon. Filling cavities in teeth scattered about the hard palate seems pointless, yet these displaced dental units may later become useful as abutments for an overdenture. Supernumerary teeth may lie in the cleft as foreign bodies for years, due to lack of liaison between surgeon and dentist.

The general statement may safely be made that routine dental care in the form of oral hygiene and filling of cavities is of the highest importance in cleft palate patients and should be unhesitatingly performed without specific instructions from the plastic surgeon. The cleft palate patient who reaches adult life with a good number of sound upper teeth, even though they are irregularly arranged, is an excellent candidate for a prosthesis which may rehabilitate him completely both in function and appearance Extraction of hopelessly destroyed teeth is usually to the best interests of the patient, but it is well for the dentist to convey his intentions to the plastic surgeon in writing before removing such teeth. The same general rule applies to teeth lying within the cleft which have no prospect of becoming useful members of the dentition.

From this point on the question of dental care becomes more complex and combined opinions are needed to arrive at the best possible solution. The highest type of cleft palate care is found at the Wisconsin,[13] Illinois,[14] Pennsylvania,[15] and Northwestern University[16] centers where all agencies concerned with the cleft palate patient work in unison. Plastic surgeon, orthodontist, prosthodontist, speech therapist, psychologist, and many others supply their important part in the total treatment. Alternate plans for management may be discussed and weighed. One of the outstanding discoveries coming from work at these centers is that delaying or altering surgical procedures frequently results in a vastly superior dental arch. At the Madison, Wisconsin center the need for orthodontic care steadily declined as surgical procedures were designed which would not interfere with growth centers of the maxilla or

produce jumbled dentitions. Prolonged orthodontic care is time consuming and costly; frequently an equally satisfactory result can be secured by judicious extractions and construction of a special prosthesis.



FIG 150 Cleft palate patient prepared to receive overdenture type of obturator. (Courtesy Dr C S Harkins and Jour. Oral Surg.)



FIG. 151. Overdenture in place (Courtesy Dr C. S. Harkins and Jour. Oral Surg.)

Speech Therapy

Even though excellent surgical and dental care have been received, few cleft palate patients achieve normal speech without skillful instruction in articulation and in the method of producing normal voice sounds. Some patients with incomplete closure of the palate can actually learn to speak well in spite of the anatomical defect. Others with a good surgical result retain the characteristic cleft palate speech unless proper training is given. The Wisconsin program is state-wide, and includes summer camp programs as a part of its tireless activity in rehabilitating cleft palate children.[1]

Gross Abnormalities of Occlusion

Case Analysis

Nowhere in the field of surgery is a firm grounding in basic dental concepts more essential than in the care of severe cases of malocclusion which are not amenable to orthodontic or prosthetic treatment. The restoration of occlusion is the most important objective of any operation which may be contemplated to improve the deformity.

Prior to making any decision regarding surgical treatment, dental radiographs, study models, photographs, and lateral and postero-anterior cephalometric radiographs should be secured. A complete history, physical examination, and laboratory survey should be performed. Unless the oral surgeon is trained in the method of tracing and analyzing cephalometric radiographs, the services of a qualified orthodontist should be engaged to determine what basic abnormalities of facial structure are present Mock operations may be done either on paper cut-outs derived from the radiographs or on duplicates of the plaster models. Neither of these truly simulates changes that will be effected at the operating table, however, for anatomical structures cannot be moved about in the manner that is possible with paper and plaster replicas of parts of the oral structures.

Occlusal disharmonies are usually accompanied by some measure of facial disfigurement. In the oral surgical approach to these problems it is important to stress to the patient that the reason for undertaking treatment is improvement of occlusion of the teeth; the appearance may or may not be enhanced in ways that the patient anticipated. In this connection it is important for the surgeon to evaluate the patient's mental attitude toward his deformity. While most of these individuals have a proper perspective toward their defect, and derive increased self-confidence and poise from the surgical procedure, psychologically maladjusted individuals may cause the surgeon no end of trouble because of their bizarre attitude. Whenever preliminary interviews reveal any evidence of deviation from a well-balanced mental adjustment toward the deformity, psychiatric aid should be enlisted to determine whether the patient is a good candidate for surgery.

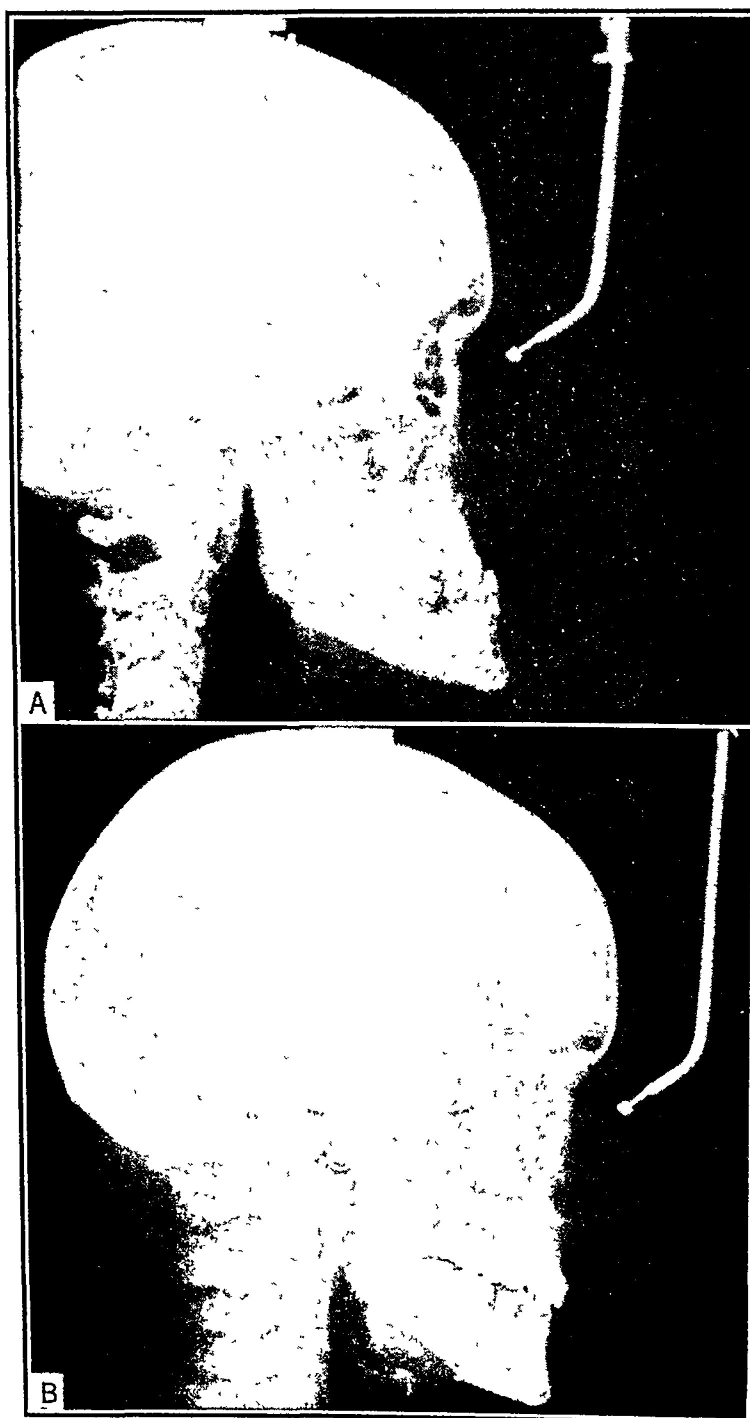


FIG 152 Lateral cephalometric radiographs. *A*, Before, and *B*, after mandibular resection for prognathism (Courtesy Dr. T D. Speidel)



FIG. 153 Superimposed tracings derived from cephalometric radiographs; solid lines represent preoperative and dotted lines the postoperative contours (Courtesy, Dr. T. D. Speidel)

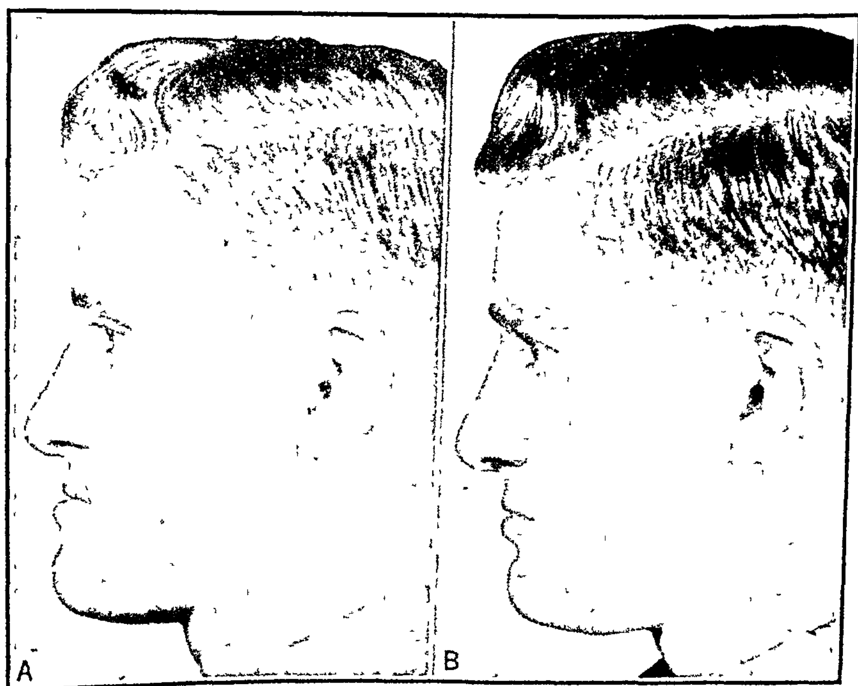


FIG. 151. Profile photographs of patient. *A*, Before and *B*, after mandibular ostectomy for prognathism (Case of Dr M. R Holland.)

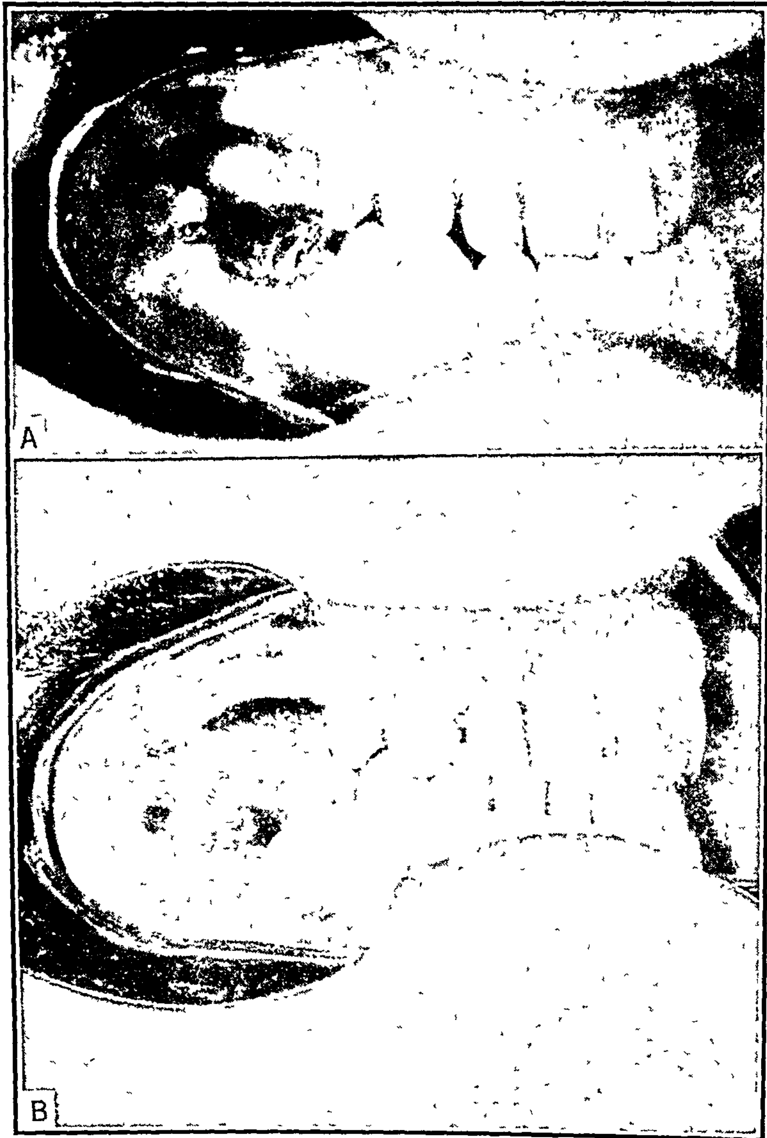


FIG. 155 Occlusion of patient. *A*, Before, and *B*, after ostectomy for prognathism (Case of Dr P E Jurgens)

DENTAL TREATMENT

Caries should be restored and a good state of oral hygiene achieved. Concurrently with the case analysis and planning of the operation, extractions are performed of those teeth which are non-restorable, badly out of line, or are in the area of contemplated bone removal. Occasionally badly decayed teeth are retained temporarily due to their strategic value during the period of fixation after ostectomy or osteotomy. When circumstances permit, orthodontic treatment and selective grinding of teeth are done preoperatively to give the best possible occlusion immediately after operation. Splints, arch bars, or basic wiring are applied at the appropriate time.

SURGICAL TREATMENT

Analysis of tracings made from cephalometric radiographs may reveal any of several abnormalities of size, shape, or position of upper or lower jaw or of the teeth and alveolar process of each. The body of either maxilla or mandible may be smaller, larger, or the same size as in the normal subject. The possibilities for variation are infinite. Surgical alteration of the position of the maxilla, for all practical purposes, may be considered out of the question. Converse has described an operation for moving the maxilla forward, but it is a complex task and not commonly performed.[17] Other than the rather minor changes that may be accomplished by working with the teeth and alveolar process, virtually all surgical treatment for severe malocclusion is performed upon the mandible.

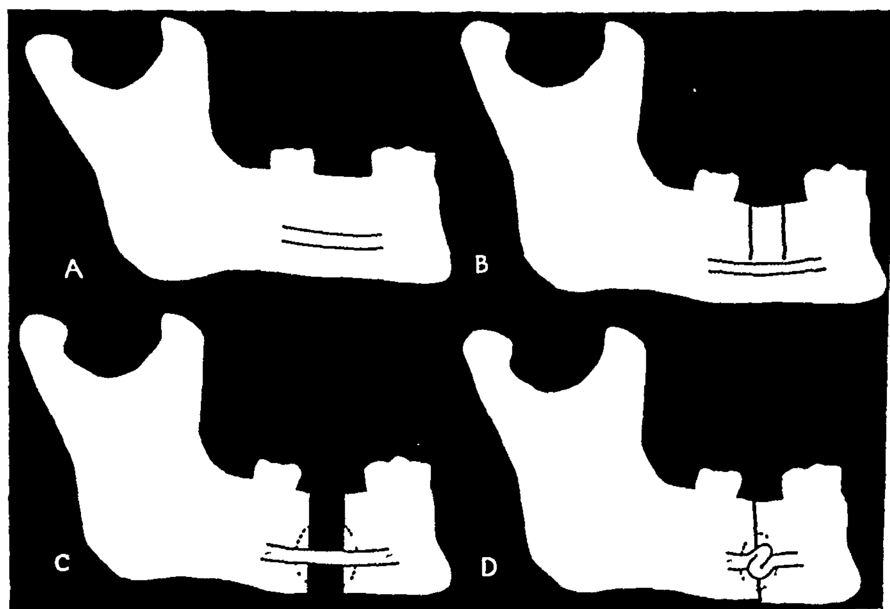


FIG. 156 Dingman operation for mandibular prognathism. *A* and *B*. First stage *C* and *D*. second stage (Dingman, courtesy Plast and Recon. Surg.)

(*a*) *Mandibular Prognathism.* This occlusal disharmony may be absolute or relative. If the maxilla is smaller or situated farther posteriorly than usual and the mandible is essentially normal the patient will appear to have mandibular prognathism. The treatment is the same as if the patient had a normal maxilla and an enlarged mandible. The essence of treatment in either case is an attempt to "match up" the two jaws so that occlusion and appearance will be improved.

The procedure of *Dingman* will be described in some detail as it is attended with many advantages not found in other operations. The inferior alveolar nerve and vessels are spared, the operation is performed under direct vision in an accessible area, and there is no

alteration of the direction of pull of the principal muscles of mastication.

When the case analysis has been completed and the amount of bone to be removed in the bicuspid or molar region has been determined, the necessary extractions are performed and brass or acrylic templates of the proper width are made. The ostectomy is accomplished in two stages.

First Stage. This is done intra-orally under local anesthesia in the office or clinic. Ample buccal and lingual mucoperiosteal flaps are reflected and two vertical cuts are made with the bur from the crest of the ridge down to but not through the mandibular canal. These slices are carried completely through from buccal to lingual. The cuts are then extended downward as far as possible *just through the cortical plate* on both buccal and lingual. The block of bone which has been outlined is left in place and the flaps are sutured back in their former position.

Second Stage. After two or three weeks the mucosal wounds are well healed and the ostectomy proper may be performed through an external approach in a completely sterile field. This stage is performed in the hospital operating room under either local or general anesthesia. Through a submandibular approach the mandible is exposed and the cuts are continued down to the lower border to complete the surgical fracture. Bone is removed piecemeal from around the neurovascular bundle. A slight concavity is made in each bone end to receive the coiled nerve and vessels. When the predetermined amount of bone has been removed from both sides, a nonsterile member of the operating team wires the teeth in their new occlusion. The sterile team then performs direct bone wiring near the lower border of the mandible. It is not necessary for the bone ends to line up exactly, though they must be in good contact; the occlusion of the teeth is the factor which determines the position of the bony fragments. The wounds are closed in layers and a firm pressure bandage is applied. The surgical fractures are usually well healed in eight weeks.[18]

Mandibular prognathism may be corrected by making horizontal cuts through both ascending rami and sliding the lower fragment backward, with or without wiring of the bone fragments. This operation shares the advantages previously mentioned of sparing the inferior alveolar nerve and vessels and of working in a sterile field. The incision is made just below the ear. Injury to the seventh nerve is a definite possibility. Severe hemorrhage from trauma to the internal maxillary artery as it courses upward on the inner aspect of the ramus, is another intrinsic hazard. Parotid fistula for a short time is fairly frequent. The operation is performed "blind" and may be criticized on that count. Occasionally only a bowing back is achieved which tends to straighten out during the healing phase, with a recurrence of the deformity. The teeth are wired in intermaxillary fixation in the same manner as in the Dingman operation.

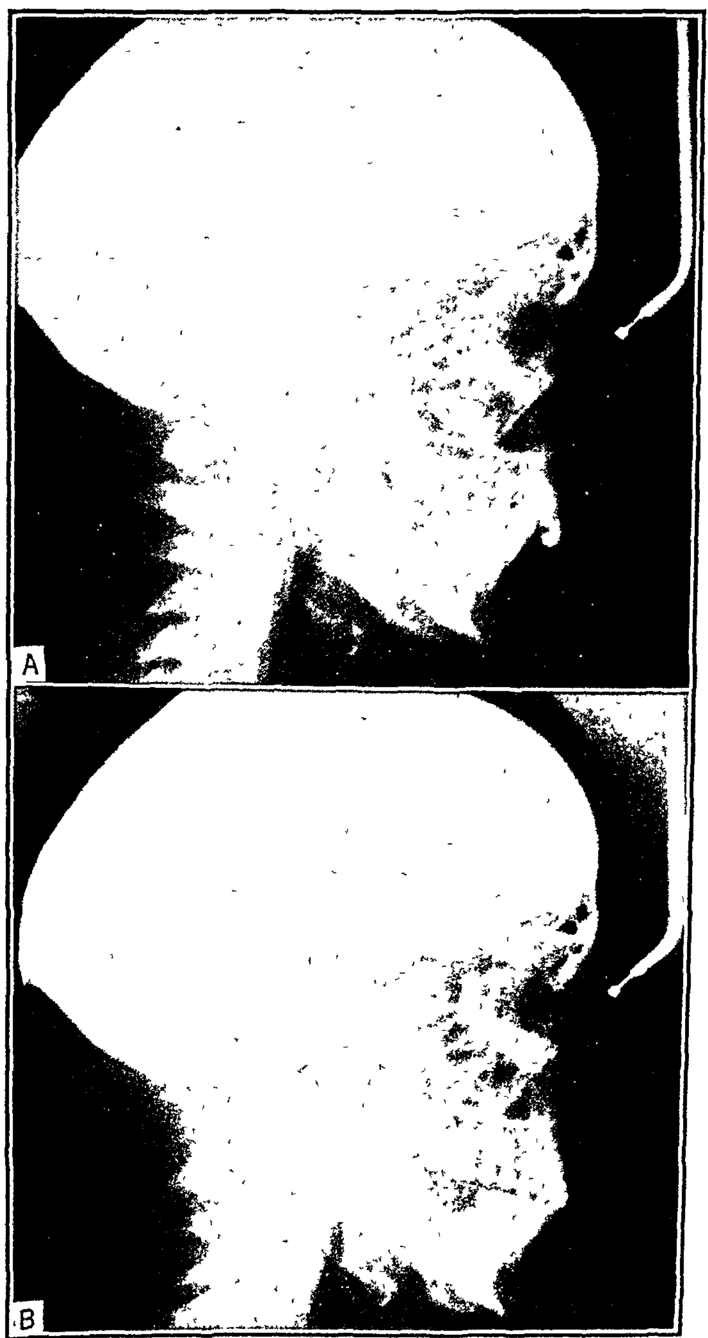


FIG 157. Cephalometric radiographs demonstrating lengthening of body of mandible by Dingman sliding osteotomy. *A*, Preoperative, and *B*, postoperative condition. (Case of Dr. D E. Brannin.)

For details of the Moose,[19] Smith,[20] Caldwell,[21] and many other procedures, the reader is referred to the individual author's publications.

(*b*) *Mandibular Retrusion.* For this deformity too, many types of operation are possible. Sliding osteotomies in the ascending ramus, and bone grafts to the body of the mandible have been reported, but the procedure which will be described is that of Dingman, wherein the body is lengthened by a two-stage "step" osteotomy. This is fundamentally more difficult than the resection of bone for prognathism, for the oral mucosa and inferior alveolar nerve and vessels must be stretched to the same extent that the bone is lengthened.

First Stage. As in the operation for prognathism, this is done in the office or clinic. Only a single vertical slice is made and it is not carried down on buccal and lingual in the cortical plate areas.

Second Stage. Extremely wide undermining of all mucoperiosteum adjacent to the area of the sliding osteotomy is performed through the submandibular approach. The sectioning of the mandible is done in the form of a step (see Fig. 157) so that the anterior segment may be advanced without losing bony contact with the posterior fragment. The amount of lengthening which may be achieved is limited to approximately 1.0 centimer as it is difficult to stretch the oral mucosa and neurovascular bundle more than this amount. The teeth are wired in the new occlusion and direct bone wiring performed in a circumferential fashion.[18]

(*c*) *Anterior Open Bite.* The Dingman two-stage method works well for this deformity also. In the first stage a V-shaped section is prepared for removal in the upper half of the mandible and in the second stage the V is continued into a Y. The anterior segment is then rotated upward so that the osteotomy appears as a Y upside down. The teeth are wired in occlusion for eight weeks as in the previously described operations.

(*d*) *Combined Forms.* Many patients with mandibular prognathism (absolute or relative) present some element of asymmetry, with the mid-line displaced to one side or the other. Other cases manifest prognathism and open bite or retrusion and crossbite. Variations of the three Dingman operations may be readily applied to individual situations.[18]

ACQUIRED DEFECTS

Soft Tissue

Facial Scarring

In the discussion of the early care of severe facial injuries it will be pointed out that little or no trimming of skin should be performed at the time of debriding the fresh wound. It is unusual for skin substance to be lost completely as a result of even the most severe facial lacerations. Assuming that careful primary skin

suturing was done with fine suture material, the resulting facial scars should be relatively narrow and inconspicuous. It is standard practice to suggest to all patients who are concerned about disfigurement due to scarring that they wait one year for the tissues to become stabilized, and if at the end of that time they still wish the scars excised it can readily be done. During the waiting period

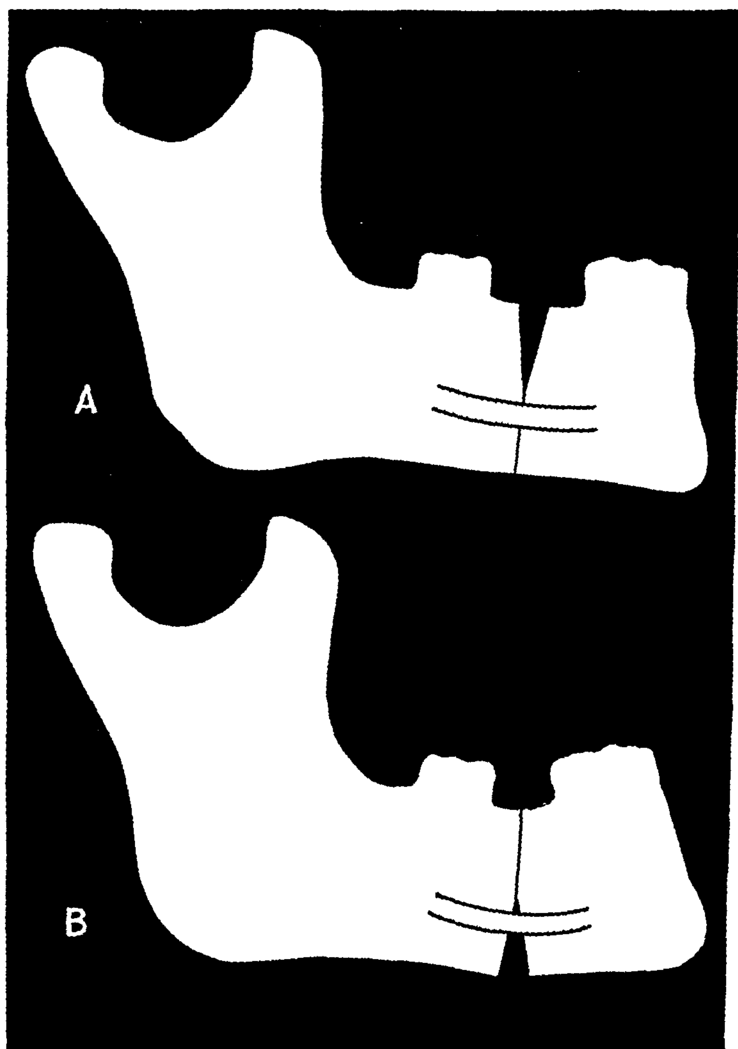


Fig 158 Plan of Dingman's method of correcting anterior open bite. *A*, First stage; *B*, final result (Dingman, courtesy of Plast. and Recon Surg.)

they should stretch and massage the scarred areas with cocoa butter for at least twenty minutes daily, to prevent the cicatricial tissue from becoming tightly bound down to the underlying structures. Most individuals are satisfied with this arrangement and few return for scar excision.

This type of work is generally considered to lie in the province of the plastic surgeon. The essence of the technic consists of excision

by sharp dissection, undermining, and meticulous closure with interrupted skin sutures of fine silk.[22] The skin sutures are removed in about two days to minimize additional scarring from this source.

Broader scars call for excision followed by much wider undermining to permit closure without tension on the wound margins. The more extreme cases require free skin grafting from back of the ear or the surface of the neck.

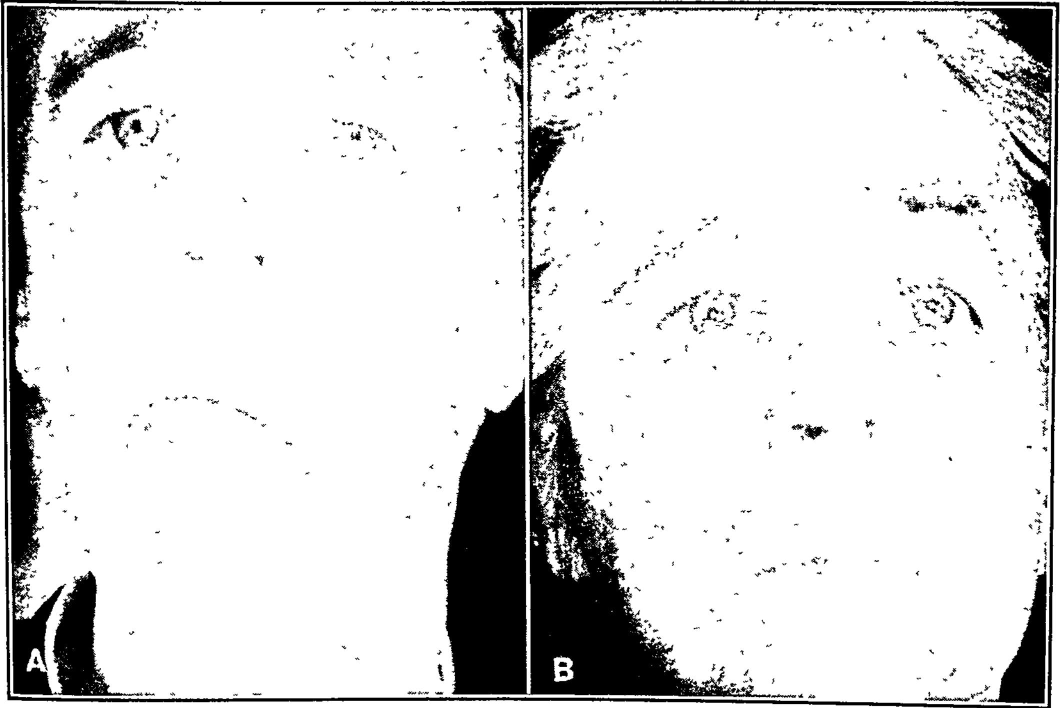


FIG. 159. Seventh nerve paralysis *A*, Before, and *B*, after insertion of tantalum wire slings (Courtesy Dr L W Schultz and E F Fowler, Plast and Recon. Surg.)

Facial Paralysis

The sagging of facial muscles due to severance of one or more branches of the seventh nerve can be improved considerably by the arrangement of subcutaneous slings made from strips of fascia lata or tantalum wire[23] which are passed from the temporal area down to several points in the cheek and to the corner of the mouth. They are inserted with long flexible needles with large eyes. This measure does not correct the difficulty in closing the eyelids nor the inability to wrinkle the forehead. Theoretically nerve suture should be possible but it is seldom attempted in actual practice.

Bone

Malunion of Fractures

Solid union of fractured bones in an abnormal relationship is occasionally seen. If too long an interval has not passed since the original injury, correction of the displacement can sometimes be

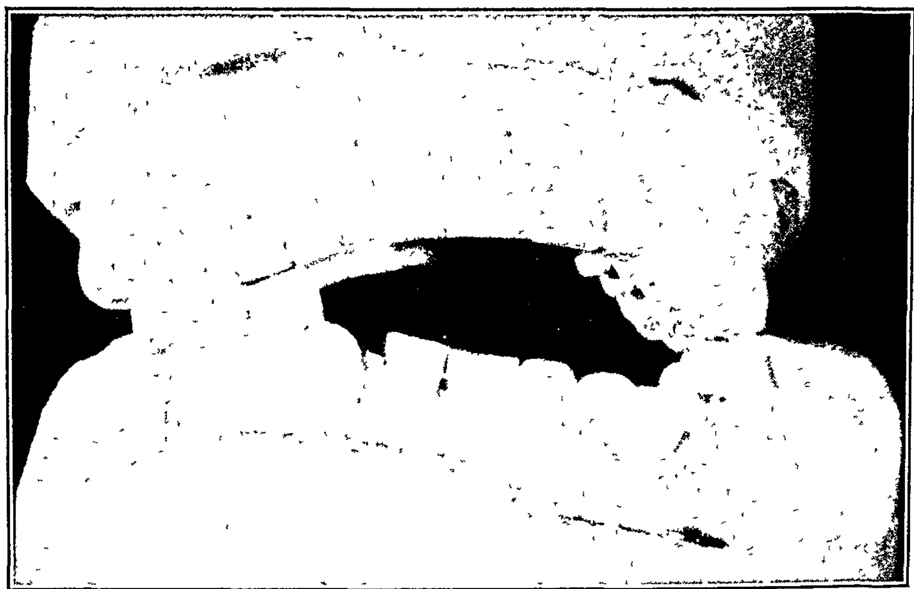


Fig 160 Malocclusion resulting from malunion of mandibular fracture. (Case of Dr. P. E Jurgens)

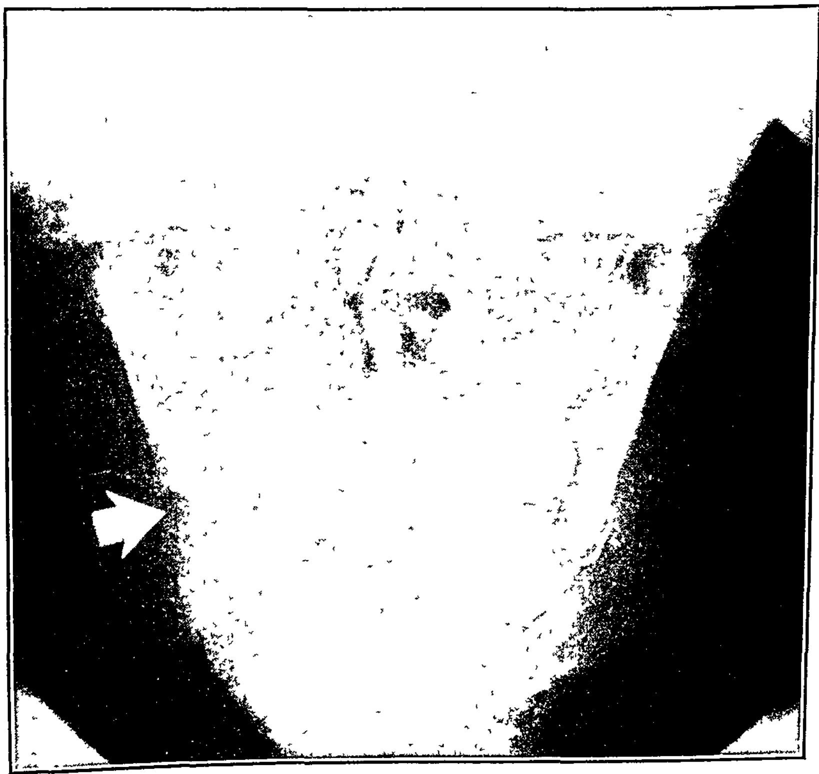


Fig 161 Nonunion of mandibular fracture.

achieved by strong intermaxillary or craniomaxillary traction for seven to ten days. In the long-standing cases it must be decided whether there is sufficient deformity or loss of function to justify refracturing, reducing, and fixing in an improved position. An open operation is required for the osteotomy, which is performed with the saw, chisel, or surgical bur. It may be necessary to resort to bone grafting to restore the original contour, for some malunions have achieved their continuity of bone substance at the expense of length.

NONUNION OF FRACTURES

This complication may result from inadequate reduction, infection, interposed soft tissue, excessive movement during the healing period, distraction of fragments by rigid fixation devices, or from some systemic factor such as anemia, diabetes, or syphilis.

Many cases can be cared for by open operation, freshening of the bone ends, and direct skeletal fixation by bone wiring or plating. Supplementary fixation should be provided by intermaxillary wiring. Other cases require the insertion of new bone substance as well, to bridge the gap and provide new fresh bone for the stimulation of osteogenesis. It is routine practice to administer prophylactic antibiotic therapy in all such cases and the percentage of successes is greatly increased thereby.

Temporomandibular Joint

TRISMUS

The stiffness of the jaws which is associated with pyogenic infections, impacted tooth removal, or contusions is usually transient and does not constitute a deformity in the sense intended here. However, penetrating wounds, burns, chronic granulomatous infections, or tumors involving any of the structures which normally elongate during opening of the mouth will frequently lead to limitation of opening.

Conservative measures are recommended for a period of six months to a year before consideration is given to surgical treatment. Physiotherapy, gum chewing, active attempts to open widely, and the use of wooden wedges should be employed. Great care should be taken not to injure the periodontium by overzealous use of prying devices. As a rule most patients with this affliction will gradually improve over a period of time to the point where they can insert a fork or spoon into the mouth. If this much opening is possible it is doubtful whether surgical treatment should be recommended, as it is always quite extensive and not uniformly successful. Occasionally an isolated scar band can be sectioned without too much surgical trauma, with improvement of the trismus. Too frequently the well-intentioned operation to remove scar results in the deposition of additional fibrous tissue so that the desired clinical improvement is not achieved.

ANKYLOSIS

Complete inability to open the jaws may be caused by ossification of one or both temporomandibular joints (true ankylosis), or by heavy deposition of scar or osseous tissue adjacent to the joint (false ankylosis). The causes are essentially the same as for trismus, with suppurative infections and rheumatoid arthritis playing the predominant role. Radiographic studies of the joints occasionally yield the desired information regarding the unilateral or bilateral status of the abnormality, but too frequently it is not possible to know whether both sides are involved until one side has been operated upon.

When the ankylosis develops in infancy there is marked interference with the development of the mandible, particularly on the affected side. By the time the patient reaches adult life there is a



FIG 162 "Bird face" deformity caused by ankylosis of temporomandibular joint since infancy (Thoma, *Oral and Dental Diagnosis*, courtesy of W. B Saunders Company)

concavity of the lower border of the mandible and the chin is severely retruded. Many carious, malposed, and unerupted teeth are found.

The preferred treatment for bony ankylosis is osteoarthrotomy, with creation of a new false joint at the level of the neck of the condyle. The operation is performed through a pre-auricular incision. The skin and fascia are retracted forward and the joint exposed. It is then possible to determine the presence or absence of bony ankylosis, for in the latter instance the condyle head, meniscus, and glenoid fossa are fused. A section 0.5 to 1.0 centimeter long is completely removed from the neck of the condyle by means of the bur, rongeurs, and chisels [24] When sectioning is complete attempts are made to move the mandible up and down passively. If this cannot be done it is evident that the other joint is also ankylosed. The second operation may be deferred for two or three weeks, so that connective tissue will enter the space and prevent open bite or retrusion after the operation on the other side.[25] The interposition of a flap of muscle has been advocated by

some authorities to minimize the possibility of recurrence of the deformity.

For cases of false ankylosis caused by contracture of the temporalis muscle or by union of the coronoid process with the zygomatic arch, Brown has advocated sectioning or removal of the coronoid process through an intra-oral approach.[26]

CHRONIC DISLOCATION

While it seems incredible that a patient could approximate the upper and lower teeth with one condyle head in anterior dislocation, the condition does occasionally occur. Figures 163 and 164 show the



FIG. 163 Unilateral chronic dislocation of temporomandibular joint Cephalometric radiograph reveals lack of superimposition of ascending rami and inferior borders of mandible

occlusion and the lateral cephalometric radiograph of the author's case. When several years have passed since the original dislocation, it is out of the question to attempt replacement of the head in the fossa. Either condylectomy or osteotomy of the neck of the condyle permit the mandible to assume a more nearly normal position. As considerable drifting of the teeth will have occurred, the occlusion must be adjusted by grinding or by restorative dental means.

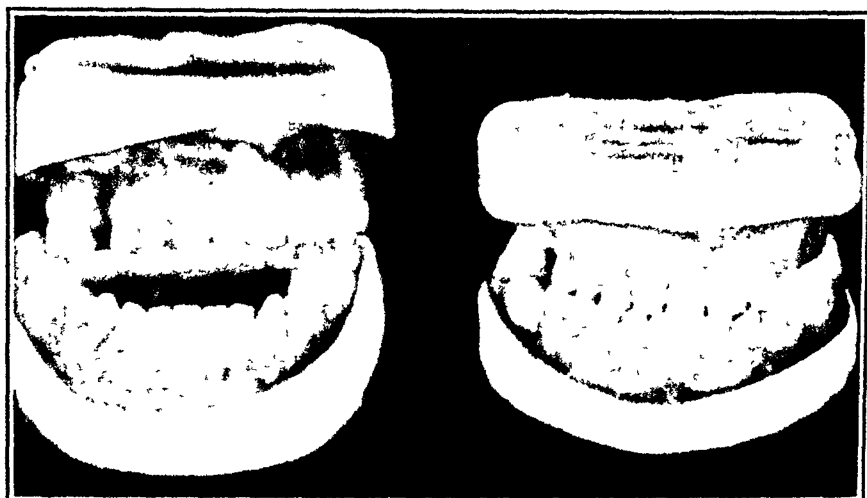


Fig 164 Same case as Figure 163; models before and after condylectomy.



Fig. 165 Same case as Figure 163 Patient: *A*, Before, and *B*, after condylectomy

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11

Injuries

INTRODUCTION

Role of the Dentist

THE majority of severe face and jaw injuries occur in rural areas, as a result of motor vehicle accidents. Some degree of brain damage often accompanies the mutilation of the face and jaws. As a consequence the patient often cannot be moved from the local hospital to which he has been taken for several days or weeks. The care of the jaw fractures thus falls to the local dentist. He has a unique opportunity to distinguish himself and his profession by promptly assuming the responsibility for care of the damage to oral structures and by rendering effective treatment based on sound principles.

As the dentist possesses the necessary skills and special equipment for working within the mouth he is able to give the patient needed services at the *earliest possible time*, so that prompt healing without deformity or infection is very likely to result. If the patient with facial and jaw injuries does not receive early care, deformities are certain to develop which will require much more complicated treat- at a later date, and with a less satisfactory result.

For these reasons the care of mouth and jaw injuries is outlined in detail in this book. The situation is considerably different than that with regard to tumors, for example, wherein the patient could travel great distances to reach more specialized care, if necessary.

Inflammation, Healing, and Repair

MICROSCOPIC CHANGES

Every injury is promptly followed by the bodily reaction known as inflammation. This process is qualitatively the same as that which attends infection, the magnitude of each phase and the duration of the inflammatory process vary with the extent of injury or the virulence of an infection. When studied in the bat's wing or frog's mesentery, the microscopic changes that may be observed following injury are as follows:

1. Contraction of capillaries and increased speed of blood through the vessels.
2. Dilatation of capillaries and slowing of the blood flow.
3. Stasis.

4. Margination and emigration of leukocytes through the capillary walls.
5. Passage of fluid exudate from the capillaries into the tissue spaces.[1]

When no pathogenic organisms are present, the inflammatory reaction is brief and mild, and it merges imperceptibly into the process of healing and repair. These effects are minimal if the wound is clean, if there has been minimal trauma, and if parts are replaced in their original position. The healing which occurs under these circumstances is known as *primary healing* or *healing by first*



FIG. 166 Inflammation following thermal injury. (Bell's *Textbook of Pathology.*)

intention. Whenever the trauma has been severe, or many pathogenic bacteria are present, or parts are not put back into their pre-injury relationship, healing must be achieved by the much slower process of *granulation* or *healing by second intention.* In healing, either by first intention or granulation, the process is qualitatively the same, the difference being in the amount and duration of the body's activity to repair the damage. Young fibroblasts migrate into the area and lay down collagen fibers to strengthen structures which have been cut or destroyed. Capillary buds grow into the wounded area, develop lumens, and form a new circulatory system. When these components of new tissue enter a *blood* clot the phenomenon is known as *organization* of the clot. In simple incised wounds the inflammatory reaction may be so minimal that primary healing may be initiated almost at once, and the quantity of fibro-



Fig 167. First intention healing. Note minimal inflammatory reaction (Bell's *Textbook of Pathology*)

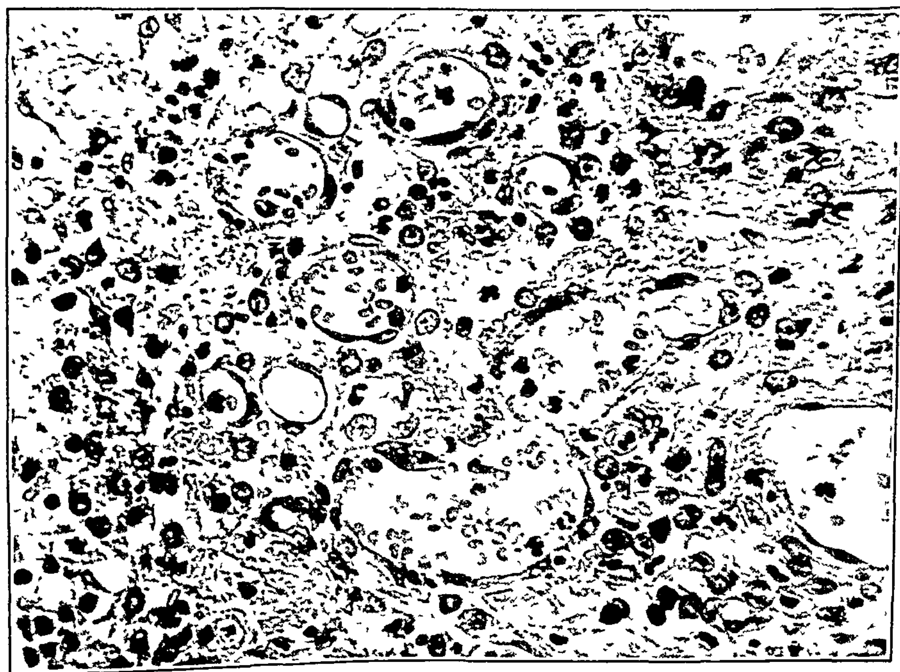


Fig 168 Healing by granulation (second intention) Note widespread inflammatory reaction (Bell's *Textbook of Pathology*)

blasts and new capillaries required to repair the injury will be very small indeed. In severely mutilated wounds or deep burns, inflammation may continue for many weeks or months, and the attempts by the body to accomplish repair will result in a massive production of young connective tissue abundantly supplied with capillaries. If excessive, this tissue is spoken of as *exuberant granulation* tissue. The picture is complicated in nearly all instances with a superimposed chronic infection, so that large numbers of inflammatory cells will be interspersed through the tissue, mainly lymphocytes, plasma cells, and macrophages. If the infectious process is acute, many polymorphonuclear leukocytes will be present and pus will exude from the surface. This status is equivalent to a *pyogenic granuloma.*

Local Signs of Inflammation

As would be expected, from the foregoing remarks on the similarity of microscopic changes occurring in injury and infection, the local signs of inflammation are similar, differing only in degree, depending on the amount of injury due to trauma or of damage inflicted by bacterial toxins. These physical signs are.

1. Calor (heat)
2. Dolor (pain)
3. Rubor (redness)
4. Tumor (swelling)
5. Functio Læsa (loss of function)

Each of these may be explained by the changes which are observed under the microscope. Redness and warmth are produced by the increased amount of blood in the part resulting from capillary dilatation. Pain is due to the increased pressure caused by the fluid exudate, or, in the case of infection, to irritation of bacterial toxins. Swelling results from the edema brought about by collection of the exudate and to a lesser extent from the increased blood supply. Loss of function is the consequence of distortion of the part due to swelling, particularly around joints, and of pain when movement is attempted.

Result of Healing in Soft Tissue

The collagen fibers laid down by the young fibroblasts which migrated into the injured area are increased in number until sufficient strength has been built up to hold the wound together. These strong fibers remain as *scar*, and steadily contract to further bring the wound margins closer together. They are inelastic and quite hard. Also, after the actual task of repair has been completed, the majority of the fibroblasts and capillaries disappear, since they are no longer needed. An old scar therefore has little cellular content and a rather meager blood supply. Although the surgeon must be fully aware that all wounds heal with scar tissue, he strives to keep the amount of it to a minimum because of the qualities of such tissue which have been described.



FIG 169 Old scar Note strong bands of collagen fibers. 30×



FIG. 170. Organization of clot following extraction of tooth (hamster) 30×
(Courtesy of Dr. R H Linn)

Repair of Bone

The process of healing in osseous tissue is essentially the same as that which has been described, except for the important part played by the osteoblasts in laying down new calcium salts and the osteoclasts in performing the necessary decalcification required to make appropriate changes in the architecture so that the bone segment will function properly. Weinmann and Sicher describe the process of healing of an extraction socket, which is similar to the healing of a compound fracture, as occurring in five steps:



Fig. 171 Stages of healing in fracture of fibula (rat). *A*, Tenth day, *B*, seventeenth day, *C*, thirty-first day, *A* and *C*, 35×; *B*, 55×. (Tam, courtesy of North-West. Dent.)

"1. Formation of a blood clot filling the socket.

2. Organization of the blood clot by proliferating young connective tissue.

3. Gradual replacement of the young connective tissue by coarse-fibrillar bone.

4. Reconstruction of this region of the alveolar process by resorptive activity on the one side and replacement of the immature bone by mature bone on the other.

5. As in a clean compound fracture, epithelialization and healing of the surface wound occurs simultaneously with the other reparative processes."[2]

Vocabulary of Terms*

Shock. A condition of acute peripheral circulatory failure due to derangement of circulatory control or loss of circulating fluid and brought about by injury.

Concussion of the Brain. A condition caused by violent blows upon the head attended with vertigo, loss of consciousness, nausea, weak pulse, and slow respirations.

Abrasion. A spot rubbed bare of skin or mucous membrane

Contusion. A wound in which the skin is unbroken

Incised Wound. A wound caused by a cutting instrument.

Lacerated Wound. A wound in which the tissues are torn.

Penetrating Wound. A wound that lays open an important cavity of the body.

Perforating Wound. A through and through wound of any part or member of the body

Debridement. A procedure used in treating wounds consisting in the removal of all foreign matter and devitalized tissue in the vicinity

Ecchymosis. An extravasation of blood, also a discoloration of the skin caused by the extravasation of blood.

Hematoma. A tumor containing effused blood.

Avulsion. The tearing away of a part or structure

Simple Fracture. One in which the overlying integument is intact

Compound Fracture. One in which there is an external wound leading to the break of the bone (Note that "external" includes any space or potential space which communicates with the outside air.)

Comminuted Fracture. One in which the bone is splintered or crushed

Greenstick Fracture. One in which one side of a bone is broken, the other being bent.

Pathologic Fracture. Spontaneous fracture, a fracture due to weakening of the bone by disease

Union. The process of healing, the renewal of continuity in a broken bone or between the lips of a wound.

Nonunion. Failure of the ends of a fractured bone to unite

Sprain. The wrenching of a joint with partial rupture or other injury of its attachments, and without luxation of bones.

Strain. An overstretching or overexertion of some part of the musculature

Subluxation. An incomplete or partial dislocation

Dislocation. The displacement of any part, more especially of a bone.

* All definitions are from Dorland, W. A. N : *The American Illustrated Medical Dictionary*, 22nd ed , Philadelphia, W. B. Saunders Co., 1951.

CARE OF THE INJURED PATIENT

The order of procedure for the care of any injured patient must give proper emphasis and sequence to each treatment procedure. Overzealous attempts to institute definitive treatment for mouth and jaw injuries on a moribund patient may lead to the grim jest, "The operation was a success, but the patient died." Management should be along the lines of the following schedule. It will be noted that the surgery upon the mouth and jaws appears fairly well down in the list.

I. Lifesaving measures.
II. Medical evaluation of the patient's general condition.
III. Treatment of injuries.
  A. Mouth and jaws.
  B. Coincidental injuries of other parts of the body.
IV. General care of the convalescent patient.

Lifesaving Measures

Prevention of Suffocation

This is the most important consideration for any patient who is injured about the mouth or face. The tongue tends to drop back and occlude the airway whenever an unconscious patient is laid upon his back, and this hazard is particularly great if there are fractures of the jaws or lacerations of the oral soft tissues. The danger is minimized when the patient is laid or transported face down, but it must be made certain, by inspection with good light, that no mucus, blood, or other foreign material is occluding the pharynx. If the subject must be kept in a sitting position, a traction suture or even a safety pin will provide a means for keeping the tongue forward. If the need exists and facilities are available, tracheotomy and the administration of oxygen may be required to prevent respiratory obstruction or anoxia.

Control of Hemorrhage

Strong digital pressure directly upon or adjacent to any bleeding facial wound will usually arrest the flow of blood temporarily. Bleeding from within the oral cavity or other anatomical spaces of the head may present a greater problem, if no surgical facilities are at hand. Strong pressure on the external carotid artery of the affected side, just above and slightly posterior to the thyroid cartilage, may reduce the flow until proper facilities for examination and treatment become available.

When possible, the bleeding vessel should be clamped with a hemostat. This should be done without regard for surgical asepsis or anesthesia, in view of the emergency. If no instruments are available, a compress held in position with a very firm pressure bandage should be applied, with due regard for preservation of an adequate airway.

TREATMENT OF SHOCK

The discussion of syncope, or simple shock, given in the chapter on complications, p. 198, should be reviewed. Every severe injury is accompanied by some degree of shock, and if this is overlooked or improperly treated the patient may die as a consequence of the profound alterations in body physiology which result from this condition. The most significant change is a reduction of circulating blood volume brought about either through hemorrhage or through loss of the circulating blood proteins, fluid, and electrolytes, into the tissue spaces due to increased permeability of the capillaries. Of the many treatment measures that might be used, by far the most important is the restoration to the blood stream of those constituents which are lacking. If the shock is due to hemorrhage, whole blood transfusion should be given. If there has been little or no blood loss, the relative percentage of red cells to plasma in the circulating blood may actually be much higher than normal, so plasma or some substitute for it should be administered. Saline or glucose solution are of little help as the molecules are so small they quickly pass through the capillary walls into the tissue spaces. Pulmonary edema, due to the injudicious administration of too much intravenous fluid, may prove fatal.

While it is unlikely that a dentist will be called upon to arrange for and perform transfusions of whole blood, plasma, or blood volume expanders, it is desirable that he be familiar with the common pitfalls of such procedures. Whole blood must not only be of the proper type but should have the correct Rh factor to be compatible with that of the patient. Many of the severe reactions and deaths which occurred during World War II were due to the fact that the importance of the Rh factor was not recognized. The hazard in the use of plasma is that it is pooled from large numbers of donors, some of whom are likely to have the virus of infectious hepatitis in their blood stream at the time their blood was collected. Transmission of the disease to the recipient requires only the tiniest amount of the virus. It is largely for the purpose of eliminating the danger of homologous serum jaundice that artificially synthesized blood volume expanders have been developed. These are usually complex polypeptides of high molecular weight. One of the most widely used is known as dextran. Such substances must be nontoxic, nonallergenic, and must remain in the blood stream long enough to supply the necessary osmotic pull which is lacking because of the depletion of blood proteins.

In addition to replacement of blood volume and depleted constituents, there are other less technical but very helpful measures that may be instituted to combat shock. Placement of the body in the Trendelenburg position, with the head lowered, reduces cerebral anemia. The patient should be kept warm but not overheated, for excess warmth tends to increase the hemoconcentration which is already present, and overburdens an already overworked heart Stimulants such as caffeine sodium benzoate, coramine, metrazol,

levophed, and vasoxyl may be given cautiously, but the patient must be watched carefully for recurrence of hemorrhage. Oxygen should be administered by mask or nasal catheter. In order to allay pain and restlessness morphine or other similar drugs may be given, preferably by the intravenous route. Intramuscular injections will not find their way into the circulation readily, due to the greatly reduced blood pressure, and the medication may enter the blood stream in high concentration later on, when the blood pressure has been restored. Some severely shocked patients have died from overdose of morphine due to repeated injections given intramuscularly under these conditions.

Control of Infection

The infections which are likely to develop following injuries are tetanus, clostridial myositis (gas gangrene), and wound infection. Tetanus should be considered as a disease to be prevented rather than treated. Prophylaxis is performed by administration of a booster dose of tetanus toxoid if the patient has been previously immunized with the same substance, and by giving tetanus antitoxin in all other cases. As the antitoxin contains horse serum, appropriate measures must be taken to prevent or minimize allergic reactions in susceptible individuals. Fortunately gas gangrene virtually never occurs in the face and jaw area. Antibiotics and the specific serums are effective in combatting the condition if it develops. Wound infections are reduced by proper debridement and surgical care and the use, now nearly universal, of prophylactic antibiotic therapy.

Rest and the Control of Pain

While the inclusion of these items as lifesaving measures may seem out of place, they are meaningful factors from the patient's point of view. Nice judgment is required to know when to simply leave a patient alone. No practitioner of the healing arts should be so naive as to feel that he alone can save a life or restore an injured patient to health. Without the many highly intricate and automatic nervous, circulatory, chemical, glandular, and cellular mechanisms of the patient, no surgical treatment would succeed. There are times when these agencies must be allowed to function without medical or surgical interference. In the case of extremely seriously wounded or injured patients who die a few hours after admission to a hospital, it is commonly assumed that for all practical purposes they were dead on arrival—they just required several hours for completion of the process. It is best to allow a reasonable period of time to pass in which a patient can become stabilized as to circulation, respiration, and consciousness, before doing detailed radiographic or regional physical examinations and before attempting surgical care of wounds and fractures.

The administration of analgesics should be withheld if there is some specific reason, such as for observation of signs of cerebral or

intra-abdominal injury. When these contraindications do not prevent, adequate doses of pain relieving drugs should be given to permit the patient to rest.

Medical Examination and Evaluation

When lifesaving emergency treatment has been instituted, a medical evaluation of the patient's status should be obtained before any steps are taken to repair mouth and jaw injuries. This appraisal of the condition of the entire body is frequently done concurrently with the rendering of emergency treatment. When the patient is to receive general anesthesia for the care of his wounds the medical evaluation, particularly of the condition of heart and lungs, is especially necessary. The physician's certification that the patient is in satisfactory condition to withstand surgery should be entered in writing in the chart. The presence of syphilis, tuberculosis, anemia, or diabetes may have an important bearing on the rate of healing of wounds.

Treatment of Injuries

Mouth and Jaws

Injuries of Soft Tissues. (*a*) *Wounds.* The most common type of *abraded wound* of the face is the "brush burn" caused by sliding or rolling on concrete or asphalt pavement. These areas should be thoroughly scrubbed with brush, soap, and water, under adequate anesthesia, to remove all partially embedded particles of grit, cinders, and road tar. If this foreign matter is allowed to heal into the wound a disfiguring tattoo will remain. After thorough cleansing and sterilization with aqueous Zephiran solution the abraded area should be covered with dry fine-mesh gauze or the same material *lightly* impregnated with sterile petrolatum or some bland ointment. A firm pressure dressing should then be applied to minimize edema and the oozing of blood or serum. Providing no evidence of infection appears, the dressings should not be removed for seven days At this time any portions of the gauze which are adherent should be thoroughly soaked with saline or weak peroxide solution before removal is attempted. Epithelialization will usually be found to be well advanced at the end of this time.

Contused wounds (bruises) should not be opened except in the rare instance where continuous bleeding is present which cannot be controlled by firm pressure dressings, since the hazard of infection is increased when the skin is surgically opened. It is customary to apply cold compresses for the first twenty-four hours, and thereafter to use moist heat intermittently, in an effort to hasten resorption of the extravasated blood

All open wounds (*incised, lacerated, penetrating, and perforating*) should receive surgical treatment. The sequence of steps that is most satisfactory is as follows·

(1) A simple cleanup of the facial area *around* the wound is performed with soap and water, brushes, gauze squares, razor, ether, alcohol, and Zephiran. At this time the wound itself is covered with sterile gauze squares and is not touched. If general anesthesia is to be used it is established before this work is done.

(2) If local anesthesia is to be used, injection is now done through these sterile skin surfaces, with the needle directed inward, toward the traumatized part.



Fig. 172. Severe facial laceration resulting from automobile accident. *A*, Before treatment; *B*, three weeks after surgical treatment. (Case of Dr. P. E. Jurgens.)

(3) The wound itself is then scrubbed and thoroughly irrigated with sterile saline. A quart or more of irrigating solution should be used with a forceful stream. Sterilized apparatus such as that used for giving enemas works very well for this purpose. A glass medicine dropper may be fixed to the end of the rubber tubing to facilitate directing the stream into all recesses of the open wound.

(4) The area is now draped in exactly the same manner as if an elective "clean" operation were to be done, and the operator and assistant scrub and don sterile attire.

(5) Debridement and hemostasis are now performed, with strict attention to asepsis and gentle handling of tissues.

(6) Any tears in the oral mucosa must be sutured shut at this point, regardless of whether the wound itself is to be closed or left open.

(7) If a large hematoma is present the surgical team should be alert to the possibility of sudden bleeding from a large vessel during the process of debridement. This should present no problem if proper preparation has been made in the way of adequate instruments, sponges, suction, and light.

(8) A thorough search must be made for foreign bodies, both organic and inorganic. Shell fragment wounds often contain not only pieces of metal but also bits of wood or clothing that have been carried in along with the missile.

(9) Trimming of tissue should be minimal, because of the excellent blood supply in the facial area. Skin should be trimmed very little if at all, as this tissue has good viability, and replacement of lost portions requires elaborate plastic procedures later on.

When debridement and hemostasis are complete, a choice must be made between two possibilities for final management of the wound:

First, the *wound may be closed* in layers with catgut, and the skin closed with fine silk sutures. It is well to leave in place a narrow rubber dam drain, leading out from the deepest part of the wound. (Insertion of the drain is performed as described for incision and drainage, p. 140.) In suturing a very long laceration of the face, Blair and Ivy advocate starting in the middle, then bisecting the distance from the middle to one end, and so on.[3] The sutures and the end of the drain are covered with fine mesh gauze, and a firm pressure dressing is applied. Due to the rarity of gas gangrene infections in facial tissues, primary closure of wounds is now practiced universally. Excessive formation of scar, with its inevitable contracture deformities, is thus avoided Patients whose facial wounds are repaired in layers and closed primarily require little after care and may resume normal function in the shortest possible time. The skin *sutures are removed* in two to four days and the wound margins supported with collodion strips for an additional ten to fourteen days.

Second, the *wound may be left open*, with the interior lightly filled with fine mesh gauze strips of dry or petrolatum gauze. A pressure

dressing is applied in the usual manner. In four days, if the temperature is normal and the wound clean, *delayed primary closure* (so-called secondary closure) may be performed. If this is not possible, the open management may be continued, but healing will be greatly prolonged and heavy fibrosis will result.

If for some reason a large penetrating wound completely through the cheek or lip cannot be primarily closed, it is considered very good practice to *suture oral mucosa to skin* around the entire outline of the defect. Scarring is prevented in this manner, and the wound margins will be in excellent condition when the time comes for the major plastic repair.

(*b*) *Burns.* The effect of burns on tissue is much the same whether they are *caused* by hot objects, boiling liquids, the flash of explosives, or caustic chemicals. A type known as the "flash burn" was encountered in many casualties during the attack on Pearl Harbor, as a result of the explosion of cordite ammunition stores. American sailors whose skin was protected only by a single layer of cotton cloth were often spared flash burning over those areas. This type of burn was also seen in survivors of the atomic bomb explosions over Hiroshima and Nagasaki. Every dentist must be familiar with the subtle hazard of *x*-ray burns of the fingers, caused by repeatedly holding dental film packets in the mouth of the patient when the exposure is made. This practice is to be condemned as foolhardy, for a severe dermatitis, leading in many cases to carcinoma, is very prone to develop.

The local *treatment* of first and second degree burns is identical with that of abrasions. Third degree burns should be cared for as open wounds, with excision of all necrotic tissue. The firm pressure dressing and seven-day wait are vitally important for this type of injury. The use of heavy greasy or oily preparations is to be discouraged. Corrosive liquids which contact the face or eyes should be immediately diluted by splashing water over the affected area many times.

Severe burns are accompanied by systemic changes indistinguishable from those seen in surgical shock, and treatment should emphasize the use of plasma or blood volume expanders, although in some cases red cells are destroyed by toxins and must be replaced. The mortality rate from burns is quite directly proportional to the percentage of body surface affected. Patients with over three-fourths of the body surface involved usually die, even though the burns are only of the first and second degree type.

INJURIES TO THE TEETH. A severe blow to a tooth will usually result in fracture or loosening, or in death of the pulp. Slight chipping of the crown may cause no serious damage providing the pulp is not exposed and the circulation to the pulp is not disturbed. Fracture of the root in the portion which is completely embedded in bone may be healed by formation of new cementum over the defect, although infection will usually supervene if the coronal portion has been loosened at all. As a result of violent trauma teeth may be

loosened, avulsed, or driven deeper into the socket. Severance of the arterial and venous supply to the pulp is the invariable consequence of such injury to fully formed teeth. Incompletely formed teeth occasionally retain their vitality in spite of such an accident,[4] but sterile or septic necrosis usually follows even a moderate blow.

While conservative therapy in the form of pulp protection, pulp capping, repositioning, and splinting will occasionally salvage a tooth and its vitality in any case of trauma, root canal filling will usually have to be performed, and even more frequently the tooth

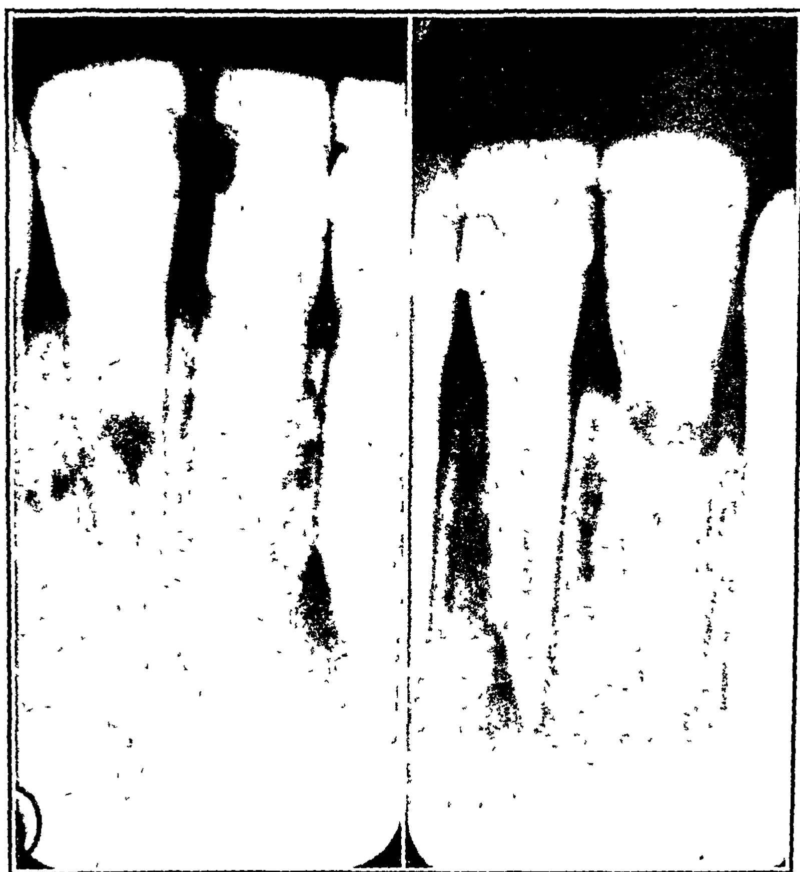


FIG 173 Late results from fracturing of teeth

will have to be extracted. It is wise to always tender the most pessimistic prognosis regarding injured teeth, for the laity are not always aware of the multiple possibilities for failure of survival. Replantation is occasionally practiced when the avulsed tooth can be sterilized and the root canal filled soon after the accident. Splinting in place for several weeks is indicated.

The frequency with which a dentist will deliberately devitalize and retain traumatized teeth will depend upon his interest and skill in the field of endodontics and his general feeling about the hazard of such a tooth becoming a focus of infection. As in the case of teeth

which lose their vitality with the enucleation of a cyst, extraction offers the best chance for complete cure from the effects of injury.

INJURIES OF THE TEMPOROMANDIBULAR JOINT. The common injuries which may occur to this joint are sprain, contusion, chronic injury (temporomandibular joint syndrome), and dislocation.

(*a*) The diagnosis of *sprain* is made by the process of exclusion, when pain and stiffness are present following injury or overuse of the joint, but the teeth are in normal occlusion and no fracture is evident on *x*-ray examination. Soft diet, hot or cold applications, and oral salicylates should be used.

(*b*) *Contusion* of the joint surfaces may cause sufficient edema to displace the head of the condyle, so that a malocclusion of the teeth results. The absence of fracture of the mandible must be confirmed by radiographic studies. It is well to treat these cases with interdental wiring and intermaxillary elastic traction to put the injured parts at rest and to gradually bring the teeth into occlusion as the intra-articular edema subsides.

(*c*) *Chronic injury* due to obvious or even to inconspicuous traumatic occlusion is manifested by audible or palpable crepitus, clicking, popping, locking, limitation of movement, pain in the joint, and radiating pain to the ear, forehead, or facial areas. The pain may be continuous or may come in spasms which simulate tic douloureux. Clinical and radiographic examination may reveal no obvious positive clinical findings, and yet the patient may complain of very severe discomfort.

Many types of *treatment* have been suggested. Schultz has favored injection with the sclerosing solution sodium psylliate to decrease the hypermobility, which he feels is usually the basis for the abnormality.[5] Many students of occlusion (Brodie and Thompson,[6] Granger,[7] Branstad,[8] Lauritzen,[9] and others) feel that the fundamental abnormality is a faulty occlusion brought about by cuspal interference which prevents the teeth from coming into centric occlusion when the mandible moves through the normal path of closure. These workers feel that, in symptomatic cases, after the teeth come into initial contact they must "slide" into an abnormal centric position which results in trauma to the condyle head, meniscus, or glenoid fossa. Correction is by meticulous grinding of the teeth in such a way that occlusal interference is removed, or by inserting some type of onlay splint to reposition slightly the mandible so that normal centric occlusion can be achieved. Whatever the validity of these theories may be, the fact remains that many patients are relieved of their symptoms by this conservative form of treatment. Sicher feels the basis of the pain lies in the muscles of mastication, which go into spasm due to improper balance. Dingman and Moorman reported 11 cases of meniscectomy for severe cases which were refractory to all other types of treatment, with good results.[10] The most recent development is the intra-articular injection of hydrocortisone in doses of 25 milligrams. Although symptomatic relief is achieved in a high

percentage of cases the improvement may be only temporary.[11] External heat, salicylates, and soft diet should be tried as initial measures for acute attacks of temporomandibular joint pain. Putting the joint at absolute rest by wiring the teeth together has given relief in a number of instances.

(*d*) *Anterior dislocation* of the head of the condyle is the most common of the complete displacements. Upward, backward, inward, or outward dislocations may occur in association with fracture of the glenoid fossa or some other adjacent part of the temporal bone, with or without fracture of the neck of the condyle. In the anterior type spasm of the external pterygoid muscle plays an important part not only in holding the condyle head anterior to the articular eminence but in producing the deformity as well. As soon as the displacement occurs, all of the vertical muscles of mastication go into spasm. This is the reason that reduction cannot be accomplished by simply pushing the chin forcibly upward and backward.

A good method for *reduction of the dislocation* is to wrap the thumbs with ends of a towel for protection, then stand to the rear of the patient, open the mouth widely to relax the masticatory muscles, move the mandible bodily to the rear, then raise the chin. If muscular relaxation cannot be obtained in this way, general anesthesia should be administered.

The patient should be warned to avoid excessive opening for the next ten to fourteen days. If the dislocation recurs, an elastic bandage should be provided to be worn at night, and in extreme cases an upper and lower tooth can be banded and connected with a short chain or ligature.

INJURIES OF BONE. (*a*) *Contusion* of any bone of the face may result in much pain and swelling even though no fracture is present. A subperiosteal hematoma often forms and thickening of the periosteum may persist for many weeks after the injury. Thoma feels that traumatic cysts arise from unresolved hematomas within the substance of the jaw.[12] There is some clinical evidence that some central giant cell tumors of the jaw arise in this way but the genesis of malignant tumors from this cause has never been proven.

(*b*) *Fracture of the jaws. Etiology.—Predisposing* causes of fracture may be *generalized* disease of bone such as fragilitas ossium or hyperparathyroidism, or *local* disease of bone such as cysts, tumors, or osteomyelitis. A breaking of the continuity of a diseased bone is known as a pathologic fracture. The *exciting* cause of a fracture is always trauma, either direct or indirect, or excessive muscular contraction.

The percentage frequency of causes of fractures of the jaws depends upon the type of environment of the population from which the patients are drawn. In wartime most fractures are due to shell fragments or other missiles, while in civilian life brawls, automobile accidents, falls, organized athletics, tooth extraction accidents, and pathologic fractures are the causative factors in the order named.

Diagnosis.—There is a tendency to depart from orderly procedure when caring for a seriously injured patient. The need for a thorough history, examination, and laboratory studies is nowhere more essential than in injury cases, for the feature of greatest interest may overshadow more subtle but equally important findings. It is permissible to change the order of steps in the examination somewhat for practical reasons. Radiographs and blood studies may be started immediately if the laboratory technicians are available, although the data from these examinations should be pondered in its proper sequence, after the history and physical. *X*-ray technicians often suggest nonstandard views in their zeal to demonstrate a particular fracture to best advantage. It is preferable to limit the first series of pictures to standard positions, for it will be necessary to repeat the exposures later on, and comparison is facilitated when a series of views all taken in the same way is available. A complete survey of the facial bones may be made very satisfactorily with:

P-A of mandible.

Right and left lateral (oblique) of mandible.

Occlusal plane of symphysis.

Dental radiographs (full mouth if possible) are desirable but not mandatory.

Waters sinus view.

Each of these is important not only for the positive but also for the negative information it may supply.

Before leaving the subject of diagnosis it should be pointed out that while the possibility of fracture is quite obvious in a patient who is bruised and swollen about the face, the presence of fracture may go unnoticed in a type of situation that may come up in any dental office. It is not likely to happen if a history and preoperative radiograph precede every tooth extraction operation. A patient may come in requesting removal of a loose tooth, usually the lower third molar. If the dentist proceeds to pluck it out without further ado he is trapped, for later developments will reveal the presence of fracture of the mandible which the patient will claim resulted from the act of extracting the tooth. In reality, of course, the fracture was caused in a drunken brawl a day or two previously. The situation is the more insidious because the patient may truly not have known his jaw was broken at the time he sought dental aid for the loose tooth. His efforts to collect damages will be the more zealous because he is convinced he has been the victim of malpractice, and there is nothing the dentist can do to prove this is not the case.

Fractures of the Mandible. While it might appear, at first thought, that the dentist should devote an equal amount of time to study of the problems of upper and lower jaw fractures, there are two reasons why the general practitioner should be especially well trained to care for lower jaw injuries. First, the incidence of mandibular fractures is much higher, at least 8 to 1. This is partly because the mandible is more exposed to injury, and also because

many patients with severe upper jaw fractures die as a result of brain damage, and will not come to treatment. Second, the complications occurring in upper facial injuries are more likely to demand the care of an oral surgeon, otolaryngologist, plastic surgeon, or neurosurgeon, so that the general practitioner of dentistry will be more prone to refer the patient for specialized care. For these reasons the study of fracture of the mandible will be considered in greater detail and it is sincerely hoped that every dentist will accept the responsibility for care of lower jaw injuries as an interesting and satisfying phase of his practice.

Types. While it would be impossible to classify all conceivable combinations of fracture line locations that can occur, some situations are likely to present more frequently. They will be listed and their characteristics briefly discussed.

Fracture of the alveolar process
Fracture of the body with teeth on both sides of the fracture line
Fracture with a posterior edentulous fragment
Fracture of the symphysis region
Fracture of the neck of the condyle
Fracture of the edentulous mandible

Fracture of the alveolar process usually occurs in areas which bear teeth, and these protruding structures may themselves be fractured or avulsed. The debridement and repair should be conservative, and all bone fragments and teeth which appear to have a reasonable chance for survival should be retained at least temporarily, in the interests of salvaging as much structure of the alveolar process as possible. The movable bone fragments are best stabilized by direct dental fixation with wires, arch bar, or splint. Intermaxillary fixation is not indicated unless the arrangement of the dentition is such that movement of the fragment occurs during masticatory function. Union is usually complete at the end of three to four weeks. Teeth or bone fragments which become infected should be removed when it is obvious there is no hope for reattachment.

Fracture of the body with teeth on both sides of the fracture line presents the simplest situation from the standpoint of ease of fixation, but introduces the problem of infection in all cases, for the fracture line is certain to communicate with the oral cavity either through a laceration of the mucosa over the alveolar process or along the root of a tooth whose root is exposed by the injury. The classical displacements of fragments due to muscle pull are of little importance in this type since teeth are present for use as fixation aids and to guide the operator in lining up the segments properly.

Fracture with a posterior edentulous fragment. This type is common and important, since the powerful muscles of mastication all attach to the posterior segment, and persistent displacement in an upward, outward, or inward direction will occur as a result of spasm of the masseter, temporal, and internal pterygoid muscles. When a tooth, such as the third molar, lies in the fracture line the possibility of infection is added to an already difficult situation.



Fig. 174. Mandibular alveolar process fracture. (Case of Dr P. E Jurgens)



Fig 175 Fracture of body of mandible with teeth present on each side of fracture line. (Case of Dr. D. E. Brannin.)

The ways in which these problems are best handled are taken up in the section on treatment.

Fracture of the symphysis region introduces three possibilities for difficulty. First, if two fracture lines are present the intervening fragment will be drawn downward and backward by the genioglossus and geniohyoid muscles, and the lateral segments will



Fig 176 Fracture of mandible with posterior edentulous fragment *A*, Before, and *B*, after open reduction (Case of Dr P. T. Fleuchaus)

collapse toward the mid-line by the action of the mylohyoid muscle. The latter deformity is particularly troublesome if the loose segment is comminuted. Second, it is often difficult to achieve absolute immobility of fixation in this region since the teeth do not lock in occlusion in a solid manner. Third, union may be delayed because of the terminal blood supply.

FIG 177. Fracture of symphysis region *A*, Before, and *B*, after open reduction (Case of Dr P. E Jurgens)



FIG 178

Fracture of the neck of the condyle is common, and the displacement may be extreme due to the pull of the external pterygoid muscle which attaches to the neck as well as to the meniscus. The ascending ramus component is shortened by muscle pull resulting in an anterior open bite, and the mid-line will be displaced toward the



Fig. 179. Fracture of edentulous mandible: *A*, Before, and *B*, after open reduction (Case of Dr P E Jurgens)

injured side. Until quite recently nearly all authorities were in agreement that even though the condyle head is completely displaced from the glenoid fossa, it should be left strictly alone, since no method short of open reduction was likely to improve the position. The principal hazards of operating in the temporomandibular joint area are the chance of ankylosis and permanent injury to the facial nerve.

This conservative course was vindicated by a study conducted by the Chalmers Lyons Club in Michigan to follow up the long term results of a series of cases of condyle fractures treated without open reduction. The most frequent treatment was simply intermaxillary fixation for a period of three weeks. The average time lapse since injury was five years. Of 120 cases that were studied there were no cases of ankylosis or deformity, and only 7 reported functional disturbance of any type. When these were analyzed all could be dismissed as very minimal or having little association with the fracture.[13]



FIG. 180 Tooth in line of fracture.

On the other hand Thoma,[14] Dingman,[15] Henny,[16] and Smith[17] have strongly advocated open reduction and internal direct skeletal fixation for this type of fracture. There can be no denying that it is desirable to replace parts in their former position, but satisfactory function with the least complicated treatment must always be the primary goal.

Fracture of the edentulous mandible is frequently simple, since that form of compounding which is due to the presence of teeth cannot occur. Healing is therefore likely to go forward without infection,

and the only problem is that of securing adequate fixation in order to achieve union in reasonably good position. The special methods of managing the fractured edentulous mandible are taken up in the section on treatment.

Principles of Treatment. As soon as lifesaving measures, medical evaluation, and soft tissue wound care have been completed, reduction and fixation of the fractured bone should be performed. There is strong clinical evidence suggesting that infection, malunion, and nonunion occur in direct proportion to the amount of time lag which elapses before treatment is given.

The question of removal of *teeth in the line of fracture* has been debated by authorities for a long time. Whenever the apex or lateral root surface of a tooth is exposed by the injury it constitutes a foreign body which may produce infection or nonunion. While it cannot be denied that these hazards are reduced by the use of prophylactic antibiotic therapy, it is questionable whether this justifies prolonged use of these drugs in an attempt to save a tooth which will probably have to be sacrificed eventually anyway. The strongest argument for retention of certain teeth which are in the line of fracture is that they may be strategically valuable in holding a bone fragment in good position when the teeth are wired in occlusion. The author feels rather strongly that each patient should be given the best possibility to heal as a result of the primary treatment, and that *all* teeth in the line of fracture should be removed on the first visit, even if this makes necessary some special procedure to reduce and fix the associated bone fragment. Even if occasional exceptions are made to this rule it is helpful to have a basic policy so that time will not be taken up in vacillation on every case.

The question of whether absolute immobility or very slight mobility should be the aim in fixation of fractures has been argued at great length by all groups of practitioners concerned with the care of fractures. While there may be some doubt as to which view is correct, there is no disagreement about the desirability of meticulous reappositioning of the fractured bone ends. Distraction, the slight holding apart of bone fragments, often leads to nonunion. The significance of this factor will be mentioned later in connection with the various fixation appliances.

It is usually not necessary nor desirable to administer general *anesthesia* for the care of mandibular fractures in adult patients, although children and some very apprehensive adults may have to be put to sleep. Heavy premedication with morphine, atropine, and pentobarbital sodium should be given. Local anesthesia may be used if desired, although many patients submit to the necessary manipulations without complaint after being well sedated.

Since antiquity the teeth have been used for the attachment of appliances for reduction and fixation of mandibular fractures. The unique advantage derived from using the teeth for attachment of appliances is accompanied by a disadvantage—the necessity of secur-

ing such precise reduction of fractures that these teeth will be in good occlusion at the end of treatment.*

The importance of these two prime considerations in the treatment of mandibular fractures varies with the number of teeth present. When only a few broken down units of the dentition remain, the ease of fixation will be reduced, but restoration of fragments to their pre-injury relationship need not be so exact. When all mandibular teeth are absent, there is no occlusion to restore, hence prompt union of bones in reasonably good position is a proper goal.

If the principles underlying fixation of the jaws are well understood, it should not be difficult to secure good results. The simplest method that will insure prompt union and restoration of good occlusion should be selected. It is better to master a few methods of treatment and use them often rather than to change constantly from one to another. Intricate and elaborate devices should be avoided whenever possible because of the cost involved and the time required for construction.

It has been stated that 90 per cent of fractures of the mandible can be managed by wiring the teeth in occlusion,[18,19] and that when sufficient teeth are present, wiring them in occlusion will constitute the best form of treatment. For the small group of cases that cannot be cared for by wiring, some other treatment plan must be devised.

Advantages of Wiring	*Disadvantages*
1. Low cost	1. Patient unable to eat solid food during treatment
2. Readily available	2. Patient might vomit and drown in his own secretions
3. No complex apparatus or technic required	3. Can not be used for fragments which do not bear teeth
4. Early fixation possible—no delay for construction of splint	
5. Proper occlusion assured at end of treatment	
6. Extractions can be performed during fixation period if necessary	

Basic Plans of Fixation: The technics that have been used and reported for care of fractures of the mandible can be grouped into four general categories, based on the effects they achieve: (1) Indirect dental fixation, (2) direct dental fixation, (3) indirect skeletal fixation, and (4) direct skeletal fixation.

Each of these may be considered for use in three main types of situations: (1) Fractures of the mandible with full dentition present, (2) fractures of the mandible with partial dentition present, and (3) fractures of the edentulous mandible.

The general plan of treatment suitable for each of these situations may be shown in the following chart.

* The major portion of the balance of this chapter which pertains to fractures of the mandible is from the author's article: Treatment of Fractures of the Mandible with Intra-Oral Appliances, J Oral Surg, *12*, 120, 1954, and is used by courtesy of the publisher

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(2) By arch bars, plus intermaxillary fixation:
Arch bar with hooks, made by the dentist
Jelenko
Winter
Erich and Austin

Annealed brass wire in 24, 25, or 26 gauge may be used in these technics but the greater strength of annealed stainless steel wire makes the use of the latter more satisfactory. A minimum of equipment is required: two hemostats, a needle holder, wire cutter, retractor, and explorer will usually suffice. In applying wires to the teeth it is a good plan to *always twist to the right* so there will never be any doubt which way to twist when retightening is to be done.

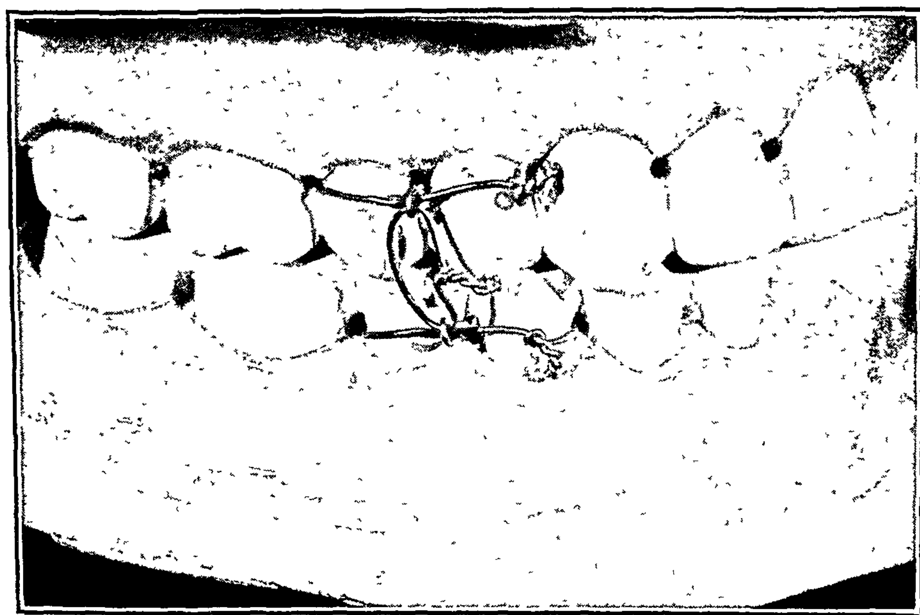


FIG. 182 Ivy loop method Three to five such "units" are usually applied (Clark, courtesy of Jour Oral Surg)

The method of *Gilmer*, introduced in 1887,[20] represents the simplest of all intermaxillary wiring methods but does possess the shortcomings of producing undue strain on a few teeth, and the necessity of removing all wiring if the mouth needs to be opened during treatment.

The *twisted loop or eyelet* method, popularized by *Ivy*, has the advantages of permitting opening of the mouth by simply cutting tie wires, without disturbing the basic interdental wiring, and distributes stresses over more teeth, but does provide a very limited number of points to which intermaxillary tie wires may be affixed.[18] Nonetheless, this method has enjoyed wide popularity because of the relative ease of application and security of fixation achieved. In cases where fragments are badly displaced the intermaxillary tie wires may be tightened gradually over a period of several days,

INDICATIONS FOR THE VARIOUS METHODS OF TREATING FRACTURES OF THE MANDIBLE

	Full dentition present	*Partial dentition present*	*Edentulous mandible*
Indirect dental fixation	Yes	Sometimes	No
Direct dental fixation	Yes	Sometimes	No
Indirect skeletal fixation	No	Sometimes	Yes
Direct skeletal fixation	No	Sometimes	Yes

Combinations of the various methods are frequently used. Further complexity develops when maxillary fractures are also present.

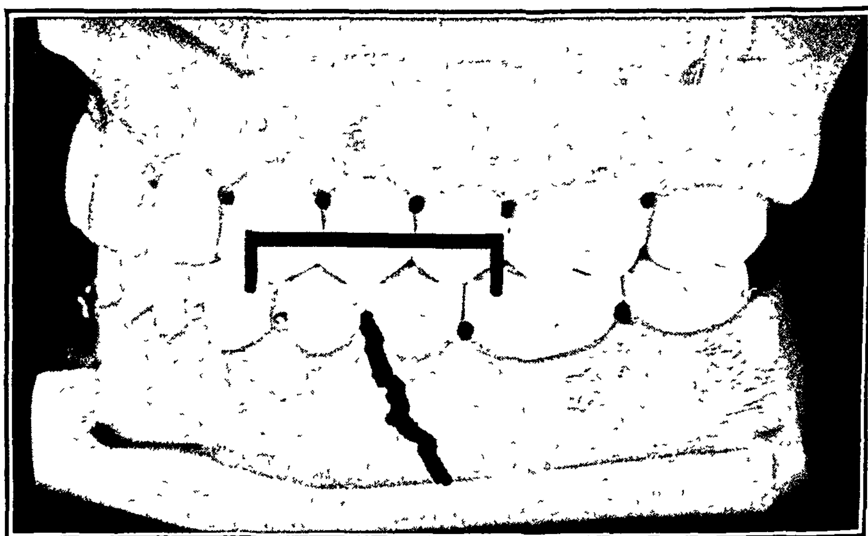


FIG 181 Scheme of indirect dental fixation (Clark, courtesy of Jour Oral Surg)

Methods of Treatment *Indirect dental fixation* is immobilization of the fractured bones through securing upper and lower teeth together in occlusion by means of wire ligatures or elastic bands. The interlocking effect of the cusps, grooves, and sulci of upper against lower teeth insures precise reduction of the fracture and good ultimate functional occlusion. Maintenance of closure of the jaws for a prolonged period is implicit in this method. The more commonly used methods of applying this principle are:

(1) By wiring the teeth and applying intermaxillary fixation:
Gilmer's method
Ivy's twisted loop method
Stout's (Army) continuous loop method
Risdon's arch method
Single tooth tie method

for battle casualties in forward areas. The elastics may be cut with scissors in the event of nausea incident to motion sickness during ship, plane, or ambulance evacuation.[24] When the patient reaches a base hospital another type of wiring may be preferred which will permit placement of intermaxillary tie wires. The loops of the Army method do not hold up well when tie wires are used in place of elastics unless extremely heavy basic wiring has been used.

Of all the methods that have been tried at this institution, that of *Risdon* has most universally filled our needs. The flexible cable arch bar provides many sites of attachment for wires or elastics.

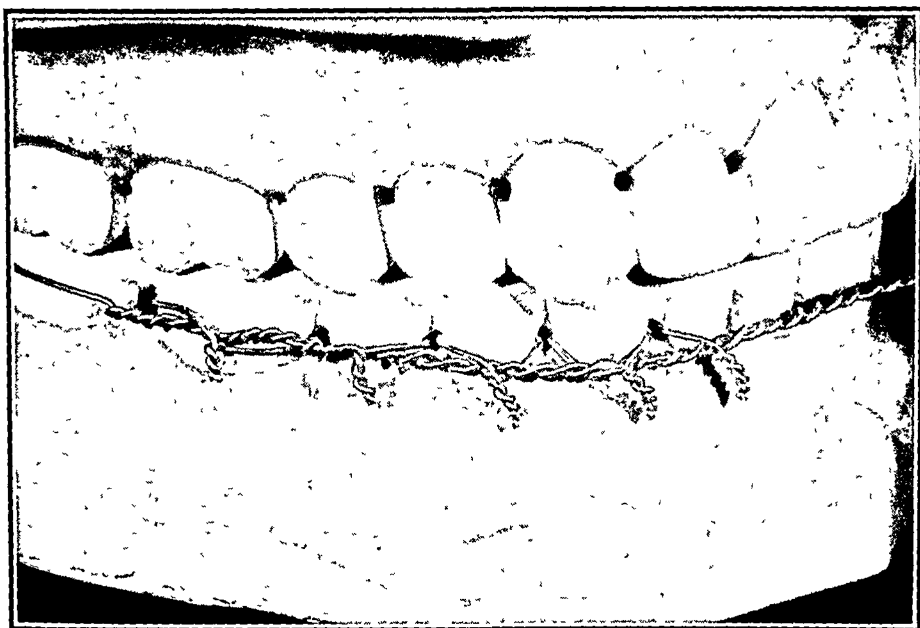


FIG 184. Risdon arch (Clark, courtesy of Jour Oral Surg.)

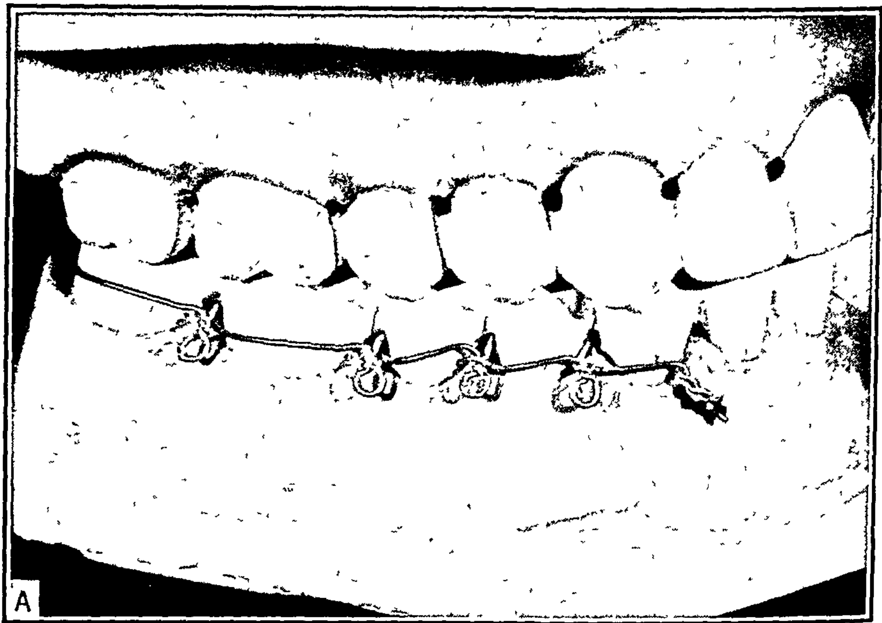
No unintended buccolingual orthodontic effect is introduced as the cable is dead soft. Many teeth share the load resulting from traction applied at any point on the arch to bring fragments into position. The technic permits forceful apposition of fragments (direct dental fixation) as well as indirect dental fixation.[21]

Occasionally it is necessary to attach an elastic band or tie wire to a *single tooth* standing alone. Many devices have been reported for this purpose ranging in complexity from specially made orthodontic bands to single wires passed around the tooth. We have found the double wire, illustrated in Figure 185 simple and serviceable. The overhand knot serves as an eyelet to receive a tie wire while the curved twisted end may be used as a hook to secure an elastic band if fairly heavy wire has been employed.

Hooked arch bars of the *Jelenko, Winter,* or *individually fashioned type* are strongly favored by some writers, particularly for gradual reduction of displacements in fractures received for treatment several weeks after injury. *Erich and Austin* describe a style which

bringing the teeth into improved occlusion and thereby reducing the displacement of fragments. Elastic bands may be applied to the hooks formed by the twisted wire ends, but if this form of traction is desired another method will usually serve to better advantage.

The *Army continuous loop* method, introduced by *Stout,* was devised to permit early intermaxillary elastic traction and fixation



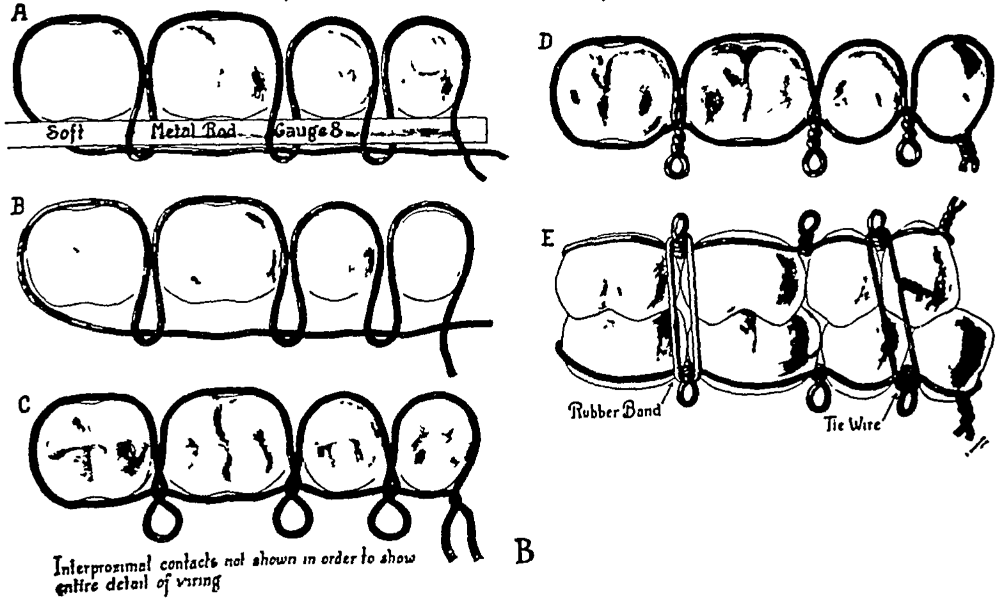


FIG 183 Stout continous loop (Army) method (*A*, Clark, courtesy of Jour. Oral Surg)

between two sections of bar lashed to the teeth. The rubber bands are applied to U-shaped projections from the arch bar segments. When sufficient separation has been achieved the appliance may be replaced by a single bar.[18]

Direct dental fixation is the immobilization of fragments by means of a splint, bar, or wire extending between two or more teeth on opposite sides of the point of mobility. In the pure sense this method provides for the mouth to be opened at will during the period of treatment. While this consideration is immediately appealing to the patient it invariably introduces certain underlying

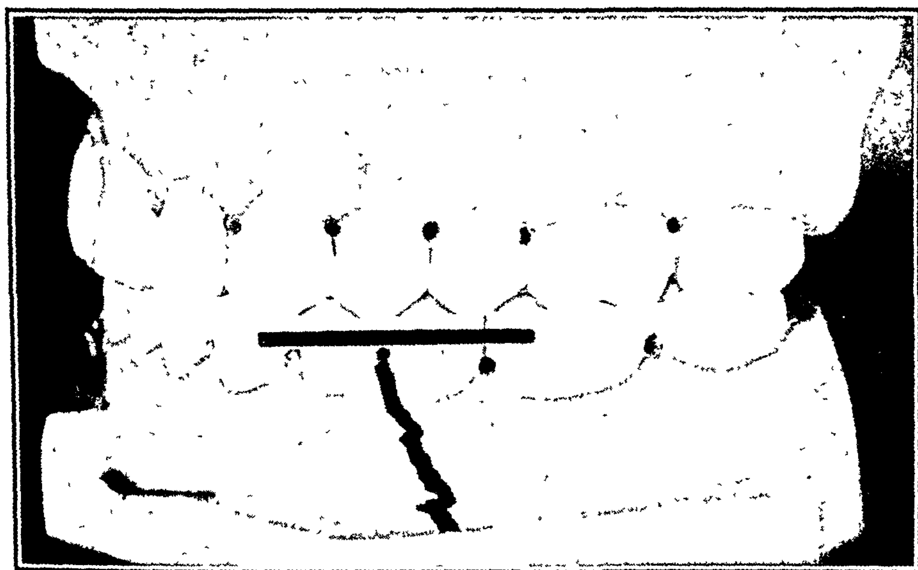


FIG 186. Scheme of direct dental fixation.
(Clark, courtesy of Jour. Oral Surg)

hazards. If rigid immobilization is not secured, if fragments are distracted, or if occlusion in the healed state is not achieved, the enjoyment of being able to open the jaws during treatment becomes a costly privilege. The most frequently used appliances in this category are:

(1) Wiring
(2) Risdon flexible arch
(3) Rigid arch bars
(4) Splints
Cast silver cap type
Sectional acrylic or silver type

(1) *Wiring.* The simplest of direct dental fixation technics would be surrounding the two teeth adjacent to the fracture line with a single wire and tightening it securely. Unfortunately this provides little stability and places unwarranted lateral stresses on the supporting structures of these teeth.

(2) *Risdon Flexible Arch.* An arch bar fashioned of twisted annealed wire (Risdon) or of (3) *rigid tempered wire*, lashed to several

may be punched out of monel metal with hooks attached, which are later bent over. This material is sufficiently pliable to permit adaptation to the teeth with finger pressure.[22] This feature obviates one of the inherent objections to the rigid arch bar principle, the necessity for making a model to permit easy and exact contouring to labial and buccal surfaces of the teeth prior to wiring in place. These authors point out that any arch bar of this type should be cut where it crosses the fracture line so that distraction of fragments with consequent nonunion will not occur. Ivy and Curtis feel that

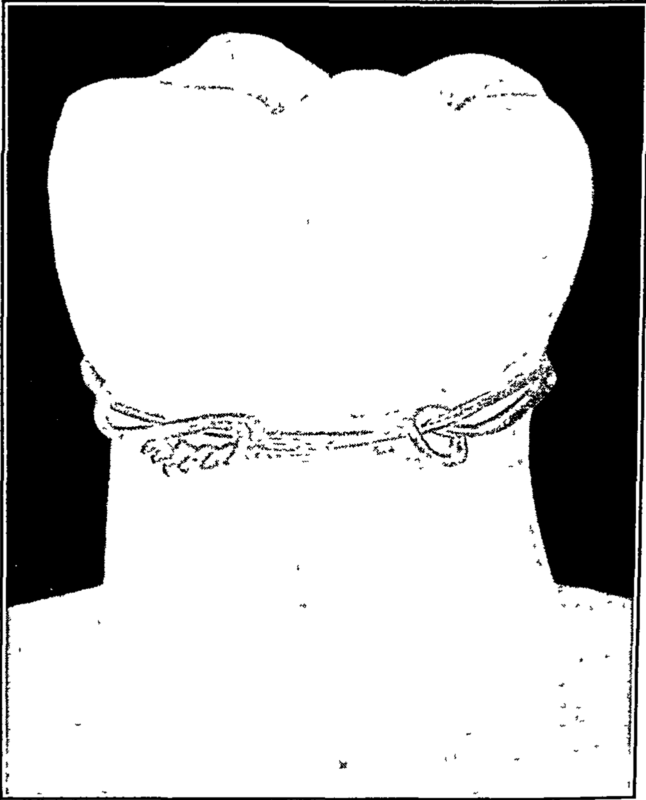


FIG. 185 Single tooth tie Useful for securing traction or fixation to an isolated tooth (Clark, courtesy of Jour Oral Surg)

if a divided arch bar is used for traction on displaced fragments it should be replaced by a continuous arch after reduction is complete. It must be recognized that rigid appliances, both intra-oral and extra-oral, may introduce the serious problem of distraction of bone ends. The high degree of success of indirect dental fixation is no doubt partly due to the subtle provision for falling together of bone ends. When good fragment contact is known to exist, and in bone grafting procedures, the rigid appliance is entirely suitable. Ivy and Curtis describe a useful variation on the divided arch bar principle which they credit to Schellhorn. Expansion of a collapsed arch in the symphysis region is achieved by lateral elastic traction

between two sections of bar lashed to the teeth. The rubber bands are applied to U-shaped projections from the arch bar segments. When sufficient separation has been achieved the appliance may be replaced by a single bar.[18]

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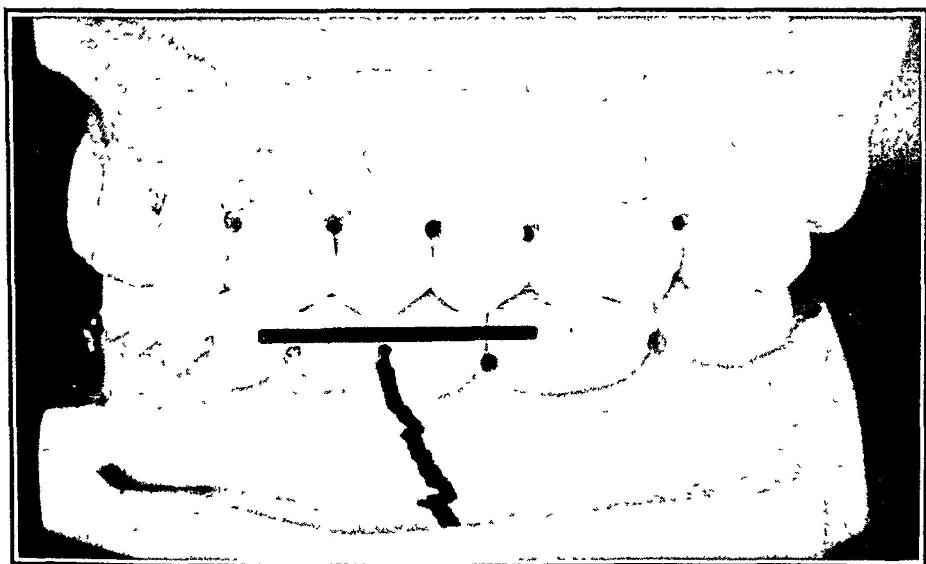


FIG 186. Scheme of direct dental fixation (Clark, courtesy of Jour Oral Surg)

hazards. If rigid immobilization is not secured, if fragments are distracted, or if occlusion in the healed state is not achieved, the enjoyment of being able to open the jaws during treatment becomes a costly privilege. The most frequently used appliances in this category are:

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(2) *Risdon Flexible Arch.* An arch bar fashioned of twisted annealed wire (Risdon) or of (3) *rigid tempered wire,* lashed to several

teeth on either side of the fracture line is an improvement in the matter of tooth strain but is unlikely to offer adequate immobilization for a complete fracture of the mandible unless combined with indirect dental fixation. Fractures of the alveolar process only are well cared for by arch bar fixation alone.

(4) *Splints* constructed in the laboratory from models have been used by many workers and are of several designs and types. The maximum of rigidity and security of attachment for long term fixation (bone grafting or pathologic fractures) is achieved by the use of *cast silver cap splints* attached to the teeth with red or black copper cement. The number of variations is limited only by the degree of ingenuity of the dentist. Splints of this type may be cast as a single piece or in sections, to be assembled in the mouth and

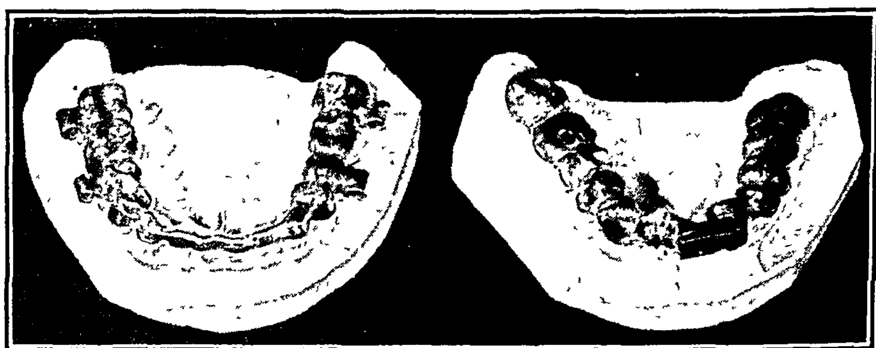


FIG. 187. Cast silver cap splints (Courtesy Dr Sylvester Koontz)

joined by screws, pins, or other types of locking devices. While cap splints do not permit closure of the teeth in centric occlusion during the period of treatment, Fry and others who have had wide experience with them feel this defect is not of serious consequence, for the normal occlusion can be established after the splint is removed.[23] If the fracture lines lie solely within the span of this appliance intermaxillary fixation may be omitted.

Construction of a cast silver cap splint is relatively simple in principle. Impressions are taken of upper and lower arches with alginate or hydrocolloid impression material. Models are made and articulated. One or two layers of pink denture wax are warmed and adapted to the section of the lower arch which is to receive the appliance. By frequent removal during shaping of the wax pattern undercuts are eliminated. Indentations are provided for teeth in the opposing arch. The splint is cast in coin silver.

The U. S. Army Dental Corps has favored sectional splints of the open occlusal type made of acrylic or cast silver.[24] It is the author's feeling that appliances of this type made of acrylic have numerous defects which make their use inadequate for difficult cases and unnecessary in simpler ones which could be cared for nicely by inter-

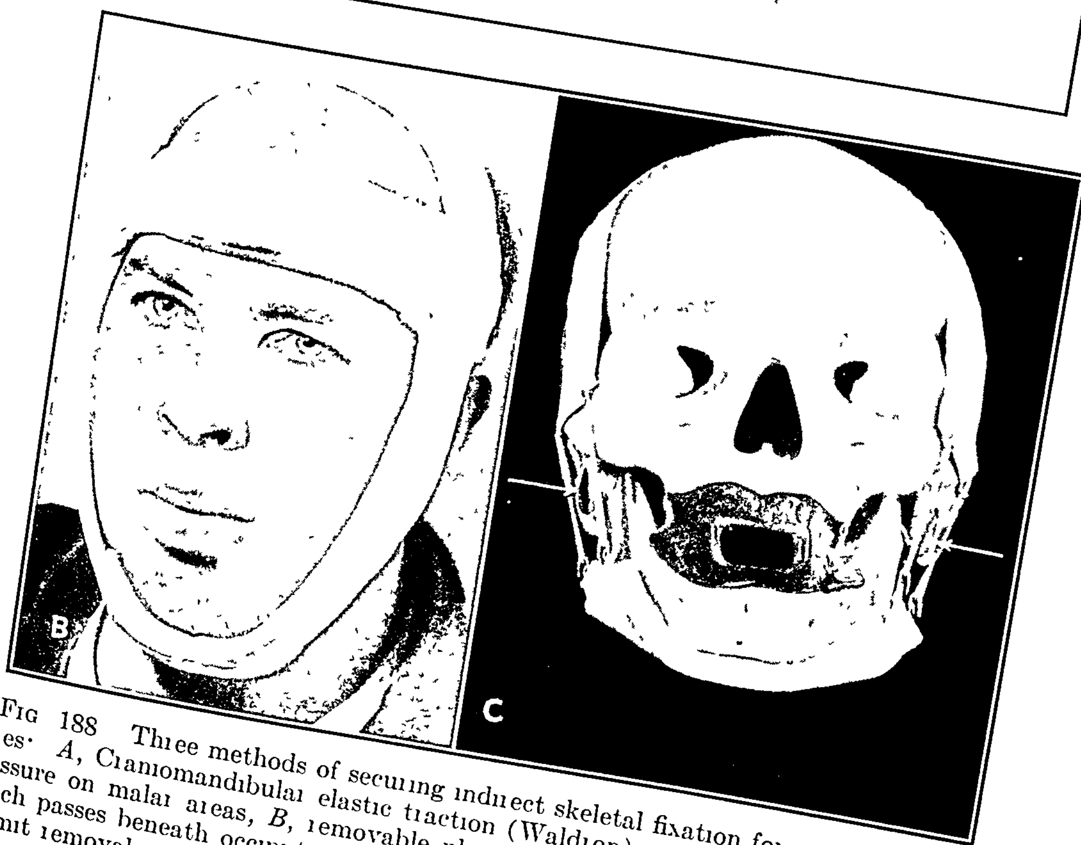


FIG 188 Three methods of securing indirect skeletal fixation for mandibular fractures: *A*, Craniomandibular elastic traction (Waldron) Note outriggers to prevent pressure on malar areas, *B*, removable plaster headcap with chin strap The band which passes beneath occiput is cut during construction and the segments hinged to permit removal Method of Dr Don E Woodard (Case of Dr P E. Jurgens); *C*, gunning splint combined with elastic chin bandage to provide indirect skeletal fixation for fractured mandible (Courtesy of Erich and Austin, *Traumatic Injuries of Facial Bones*, W B Saunders Company)

maxillary wiring. If the teeth are not sufficiently bell-shaped, retention is very difficult, for acrylic does not have the rigidity of metal. Furthermore, they are unclean and encourage inflammation of the gingival tissues upon which they rest. When made of silver the sectional splint gains better rigidity but construction is more difficult than for the cap type. Cementation to the teeth would help in the matter of cleanliness but is not recommended by the proponents of sectional splints.

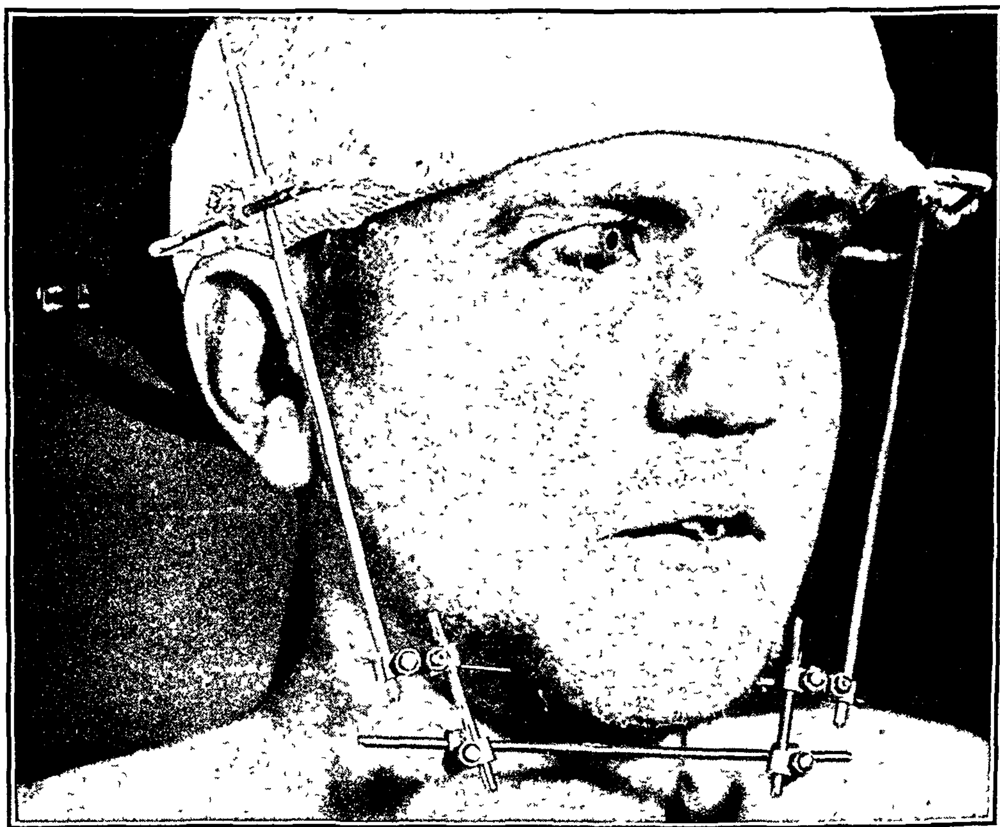


FIG 189 Craniomandibular fixation with Steinmann pin through symphysis (Courtesy of Brannin and Scholtis, Oral Surg , Oral Med , & Oral Path)

In summary, if a splint is to be used there should be absolute therapeutic indications for it, to justify the additional laboratory and chair time, and it should be superior in the matters of cleanliness, security of attachment, and rigidity.

Indirect skeletal fixation achieves stability of the fractured bones either by molding the displaced fragments to a denture or saddle splint with wires, bandaging, or skeletal traction, or by the insertion of several pins which are all securely joined to a common external bar. Completely or partially edentulous cases will be considered here. Treatment measures in this group include:

(1) Dentures or Gunning splint with head bandage

(2) Dentures or Gunning splint with skeletal fixation to head cap
(3) Circumferential wiring
(4) External pin fixation

(1) The simplest example is insertion of the patient's own full *upper and lower dentures* with application of an *elastic bandage* exerting upward traction on the mandible. Waldron has demonstrated that much greater comfort will be provided if a headcap bearing lateral projections of sheet metal is constructed for this purpose. The elastic bandage is fastened to these outriggers and pressure thus removed from the malar and temporal areas.[25] If the dentures are not available, a splint may be fashioned from models of the arches after the method of *Gunning*.[26] While these methods may be criticized on many counts, their simplicity and conservatism recommend them for uncomplicated cases.

(2) A combined intra- and extra-oral method for treating certain fractures of the edentulous mandible consists of passing a *Steinmann pin* transversely through the mental protuberance and attaching it to a *plaster head cap* with suitable clamps and vertical sections of welding rod material.[27] This seemingly radical measure is actually well tolerated by the patient and eliminates the discomfort and lack of security inherent in bandages. It may be used as a supplement to direct bone wiring or as a substitute for the bandage in the technic described above.

(3) *Circumferential wiring* with assemblage of multiple mandibular fragments against a lower denture or saddle splint has been ardently advocated by many writers as a good method of treating fractures in partially or completely edentulous cases.[18,19,22,24] The author abandoned this method long ago after observing the mucosal pressure ulcers and excruciating pain that were produced when the wires were tightened sufficiently to produce immobility of the fragments. It is my feeling that an open reduction with wiring or plating, under antibiotics, is now the treatment of choice in this class of fractures, if the simpler methods mentioned above are not adequate.

(4) *External pin fixation* devices of the Roger Anderson type have been widely hailed as a valuable contribution to the armamentarium for treatment of jaw fractures. The advantages claimed are that they will effectively permit reduction and fixation of fractures without an open operation, and that the patient may open the mouth at will during treatment. The disadvantages, besides rather high cost and need for considerable skill by the operator, are largely in the form of refutation of the claims for these devices. The argument is essentially between proponents of external pin fixation versus those who favor open reduction and internal fixation of fragments. For the general practitioner of dentistry who is seeking some way of avoiding open operations for complicated fractures, the pin method will not prove to be a satisfactory solution.

Direct skeletal fixation is the uniting of fractured bones by mechanical means through an open operation. This method is sometimes

spoken of as internal skeletal fixation to distinguish it from the external pin fixation method. These procedures are usually performed from the extra-oral approach so that an aseptic field can be maintained. The technics providing this effect are:

(1) Plating
(2) Direct bone wiring



Fig 190 External pin fixation for fractured edentulous mandible A and B, Before, and C and D, after fixation. Union failed to occur, due to distraction effect, in spite of apparently good position. Open reduction, plating, and bone grafting were required later.

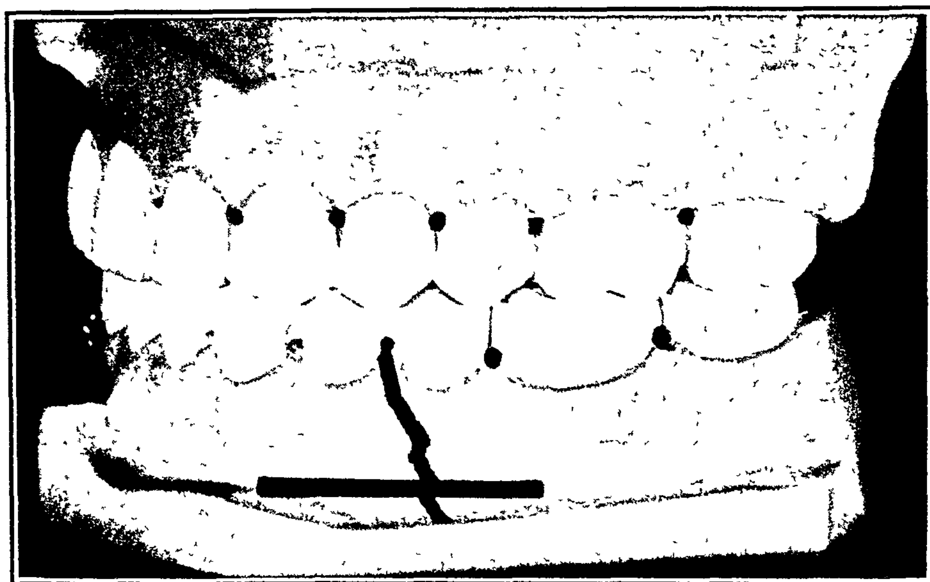
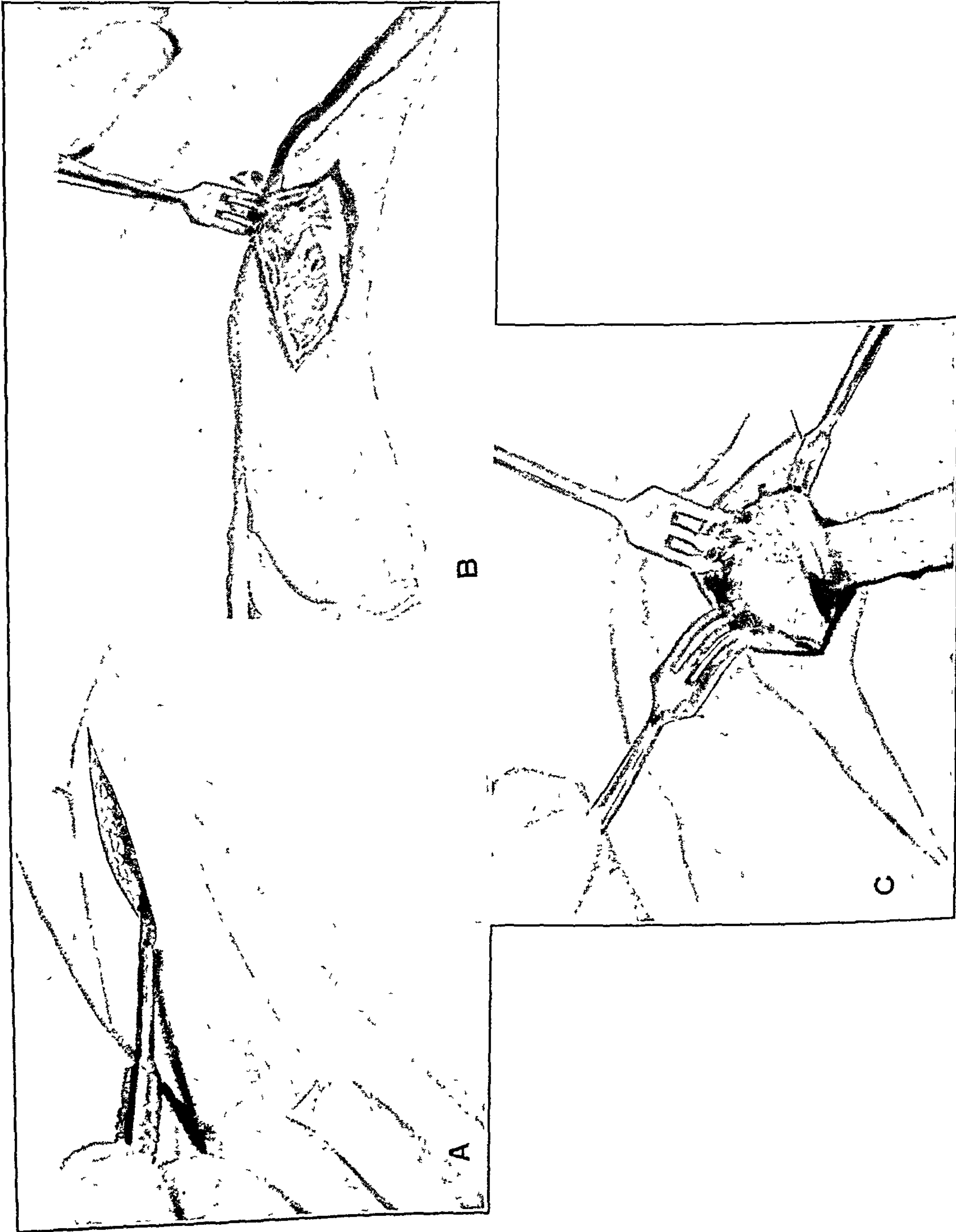


FIG. 191. Scheme of direct skeletal fixation. (Clark, courtesy of Jour Oral Surg)



FIG. 192. Lane plate applied to mandible through external approach. (Case of Dr. D. E. Brannin)

Open reduction of fractured mandibles has been avoided in the past because of the dread of osteomyelitis. With prophylactic antibiotic therapy these procedures are now being performed as a matter of course, even in the presence of salivary contamination, with prompt healing the usual result.



(1) The application of a *Lane or Ferguson plate* from an intra-oral approach is virtually impossible except in the anterior region, and even here the superior access provided by an external wound makes the latter course preferable. Plating provides excellent stability but should be used with caution in cases where teeth are present, for some slight warping from the pre-injury alignment is almost certain to occur, producing malocclusion.

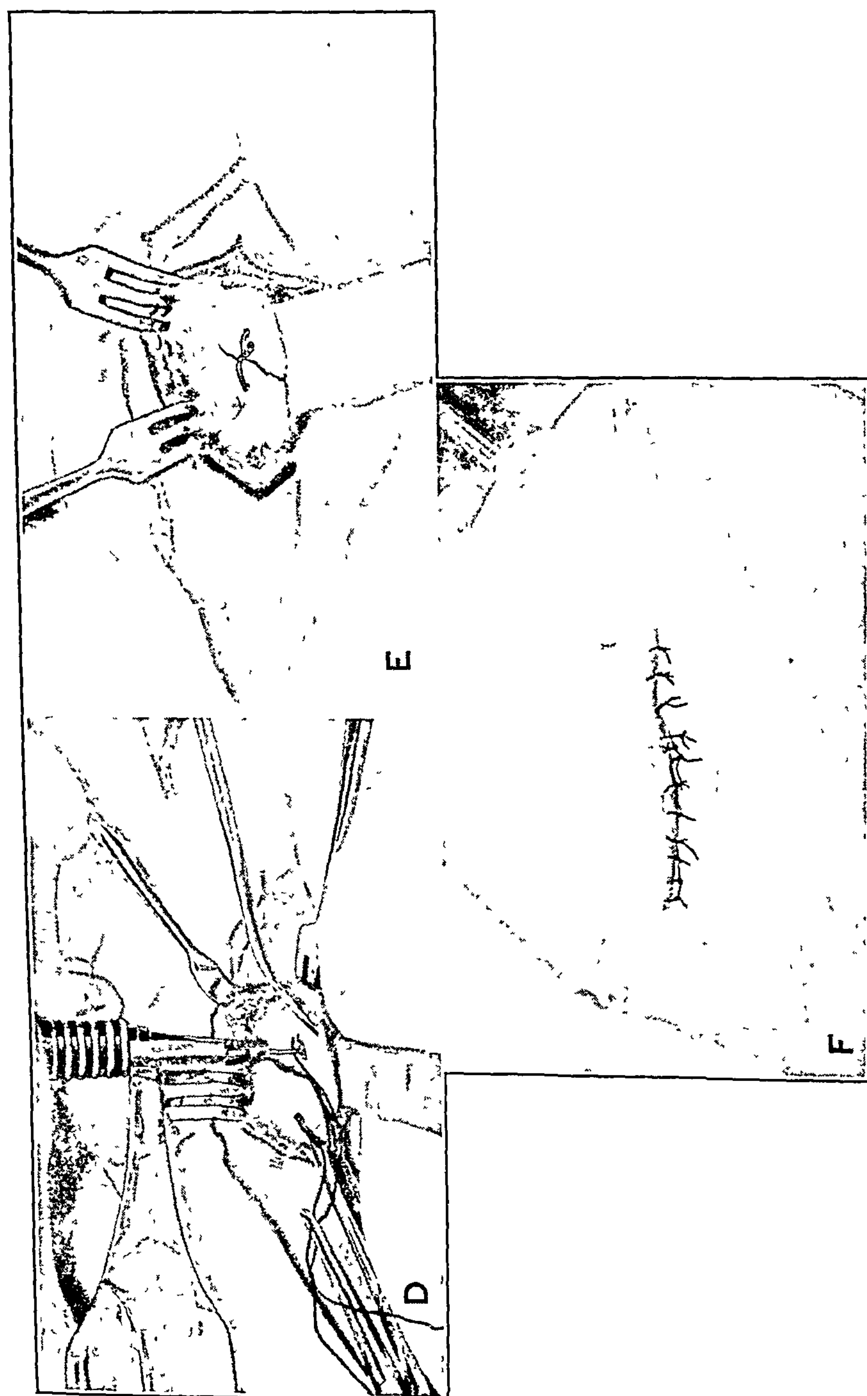


Fig. 193 Open reduction and direct bone wiring for fracture of the mandible. *A*, Incision; *B*, mandible exposed; *C*, fracture displacement demonstrated, *D*, holes drilled and wire passed, *E*, fracture reduced and fixed, *F*, wound closed.

(2) Intra-oral *direct bone wiring* is technically feasible and has been reported by Kazanjian,[28] but this too is generally accomplished through an outside incision. The latter permits good exposure of the lower border of the mandible so that fragments can be precisely reduced and fixed. (See Figs. 193, *A–F*.) Direct bone wiring with a single loop or two loops in criss-cross fashion permits fragments to assume their proper position and carries the advantage mentioned earlier in connection with wiring of teeth, that the bone ends are not held apart by any rigid device. Direct bone wiring should be supplemented with intermaxillary fixation whenever possible.



Fig 194 Maxillary alveolar process fracture. (Case of Dr. P. E Jurgens)

One final method of inta-oral fixation, difficult to classify under the headings used in this discussion, will be briefly mentioned to illustrate the commendable tendency to abandon complex gadgets when superior treatment methods become available. For control of an upriding posterior edentulous fragment Kazanjian in 1933 recommended a splint on the lower posterior teeth with a projection prong extending downward and backward to engage the anterior aspect of the ramus.[28] Padgett described a similar method consisting of a splint applied to the upper molars with an extension bar containing a jack screw for downward and backward reduction of the displaced fragment. He conceded that the appliance was difficult to make and was uncomfortable for the patient.[19] In the only instance where I have seen this method tried, much pain and little control resulted. In 1942, following the a[illegible]

Kazanjian[29] stated that he had modified his former view and had come to favor open reduction for fractures with marked displacement involving an edentulous fragment. This instance typifies the proper evolution of better treatment methods that is likely to result from any pertinent new discovery in the field of surgery.

FRACTURES OF UPPER FACIAL BONES. Since the maxilla is joined by immovable suture lines to all of the upper facial bones, it is customary to include them all together when fractures of the middle

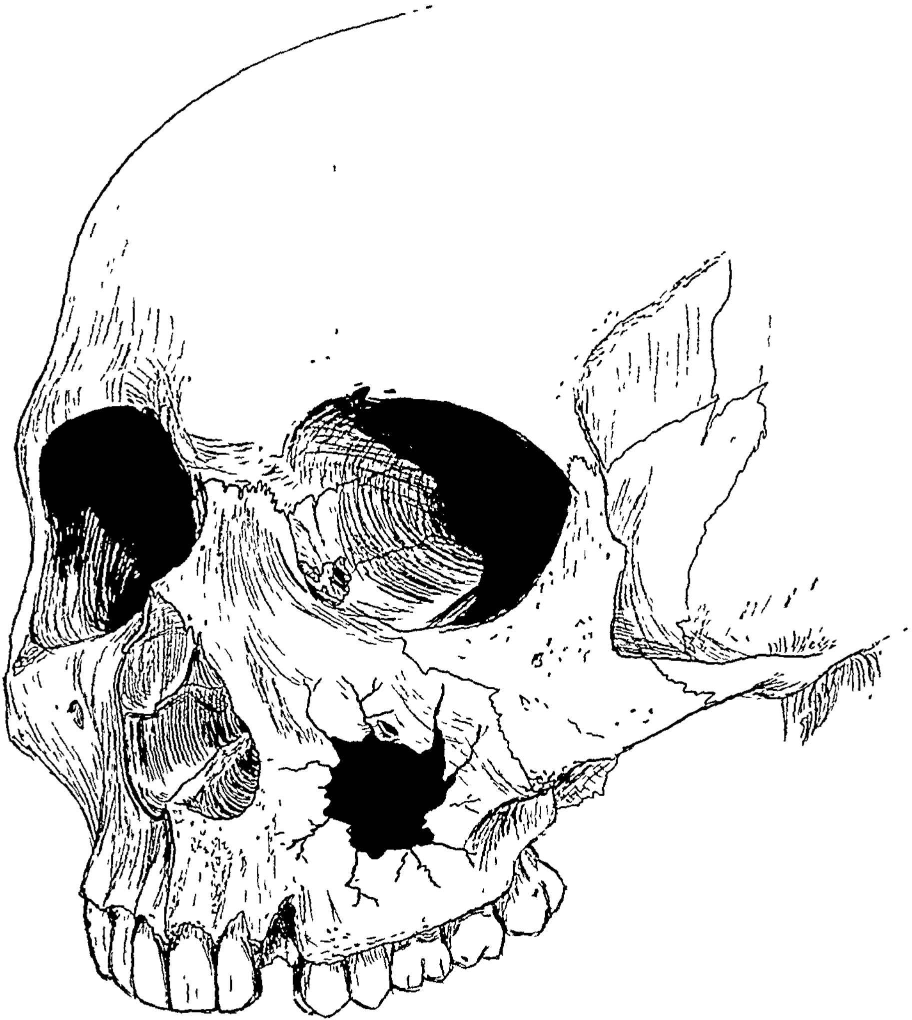


FIG. 195 "Punch type" fracture of maxilla

third of the face are being considered. For purposes of simplicity this discussion will be confined to fractures of the maxilla, nasal bones, and malar bones.

Fractures of the maxilla may be classified as follows:

Fracture of the alveolar process
Punch type
Half of maxilla detached from skull

Entire maxilla detached from skull (floating maxilla)
- Transverse
- Pyramidal
- Transverse facial. (The three subtypes are suggestions of Erich and Austin[22].)

Alveolar process fractures of the upper jaw resulting from external violence are cared for in much the same way as those of the mandible. However, reference should be made to that part of the chapter on complications resulting from extraction accidents in regard to special considerations associated with injuries to the maxillary sinus (p. 184).

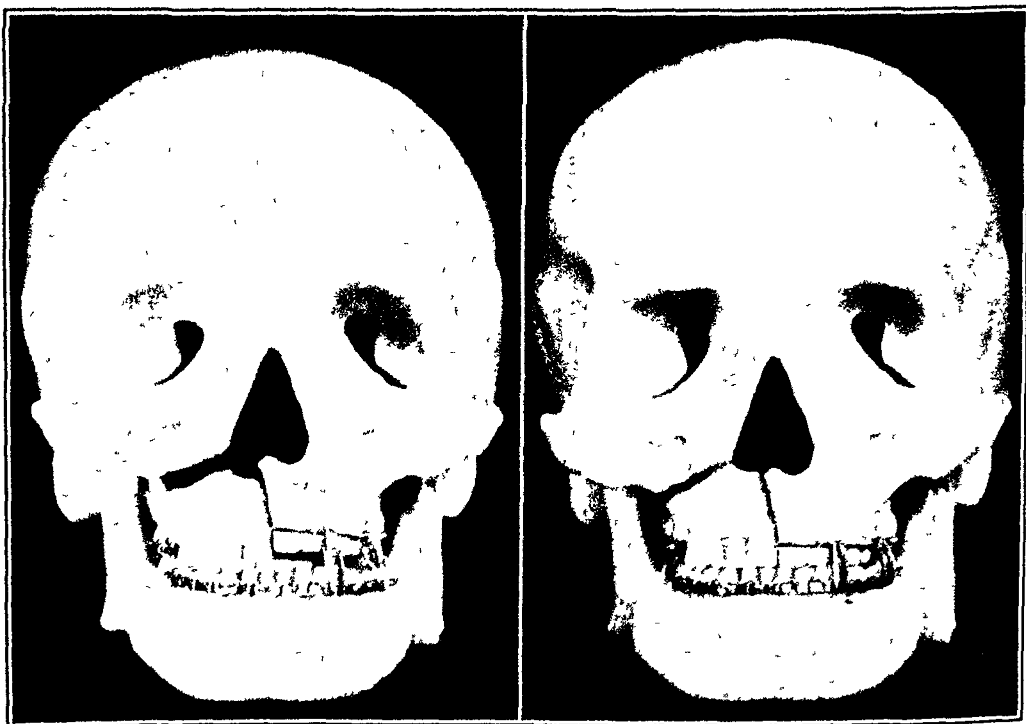


FIG. 196. Fracture of half of maxilla, showing method of reducing and fixing with intermaxillary elastic traction applied to the uninjured side (Erich and Austin, *Traumatic Injuries of Facial Bones*, courtesy of W. B. Saunders Company.)

The *punch type* fracture is a term coined by the author during World War II to describe the injury resulting from shell fragment or bullet wounds of the upper facial bones. In a series of 150 cases reviewed in 1945, over 50 per cent of the fractures of the maxilla were of this type. It is characterized by a jagged hole through one or more of the thin bony plates, hemorrhage into the antrum, and absence of separation of the maxilla from the skull. Injuries to the nose, eyes, and brain are frequent. Treatment is directed primarily at care of the associated soft tissue wounds, sinus infection, and regional injuries.[30]

When *half of the maxilla* is detached from the skull and virtually all of the teeth are present, the mandibular occlusal plane and uninjured side of the maxilla are utilized as fixation devices. Wiring the teeth together on the *normal* side provides the essentials for reduction and fixation, as these fractures tend to drop downward due to gravity. In actual practice intermaxillary traction is generally applied to both sides so that minor discrepancies in occlusion can be corrected by lateral or diagonal forces.

Detachment of the *entire maxilla* from the skull, either *en masse* or comminuted, is often referred to as a "floating" maxilla. *Diagnosis* of the presence of any such fracture is made largely on the basis of findings resulting from manipulation, rather than radiographs. The left hand is placed on top of the patient's head to stabilize it, then the thumb and forefinger of the right hand grasp the alveolar process and make forceful movements up and down, laterally, and in a rotatory manner. The examiner watches some fixed point such as the pupil of the eye, while at the same time noting whether the maxilla moves with relation to the fixed object. The Waters sinus and lateral view radiographs, inspection for nasal bleeding or spinal fluid drip, and study of the occlusion will also give helpful information. Since most fractures of this region are caused from smashing of the face against an object such as an automobile dashboard, the bones will usually be displaced backward. The entire bony mass may be pushed upward into the other bones of the skull where it becomes securely impacted, although more frequently movement is present and the maxilla drops downward due to the effect of gravity. The malar bone may be driven inward as a wedge, fracturing the maxilla from the skull and making it impossible to raise it until the malar bone is drawn out to its normal position.

As described by Erich and Austin, the *transverse fracture* line passes horizontally through both antra and the nasal cavity. The *pyramidal* type extends through both antra, both orbits, and the nose, and the *transverse facial* goes straight across both orbits and the upper portion of the nasal cavity.[22]

Complications. Cerebrospinal fluid rhinorrhea is almost invariably present with pyramidal and transverse facial fractures, due to fracturing of the cribriform plate of the ethmoid and tearing of the dura in the anterior cranial fossa. This grave complication immediately introduces the possibility of meningitis as a result of ascending infection. A differential test between spinal fluid and nasal mucus may be made by collecting a few drops on a handkerchief and allowing them to dry. With spinal fluid the cloth remains soft, while mucus causes it to become stiff, as if starched. Unfortunately, mucus is nearly always present in the nose so the test may not always be valid.

The question of concomitant fracture of the calvarium is not so important as the associated damage to the brain itself. Concussion, contusion, or actual laceration may be present. Displacement of

the eyeball so that double vision results after edema has subsided is frequently present when the floor of the orbit is displaced downward. This is especially likely to occur when a depressed fracture of the malar bone is also present. Vision may be reduced or lost because of severe intra-occular damage.

Treatment of any case in which the entire maxilla is detached from the skull must provide for restoration of the occlusion of teeth and union of the bones in their correct pre-injury relationship. Restoration of the occlusion is usually readily achieved by wiring the upper

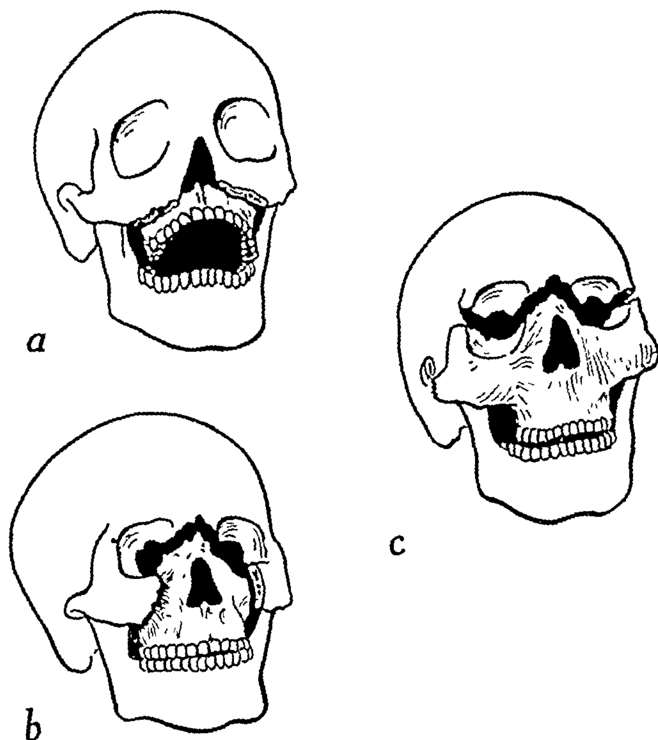


Fig. 197. The three types of complete separation of the maxilla from the skull *a*, Transverse fracture of the upper jaw; *b*, pyramidal fracture; *c*, transverse facial fracture (Erich and Austin, *Traumatic Injuries of Facial Bones*, courtesy of W B Saunders Company)

teeth to the lower. If the mandible has also been fractured, it may be necessary to arrange its fragments in proper order by means of direct dental fixation or direct skeletal fixation first of all, so that there is a plane of orientation against which the maxillary teeth may be adapted. For stabilization of the maxilla against the skull several methods are available.

(1) Indirect skeletal fixation in the manner described for control of edentulous fractures of the mandible may be used. Upward traction by an *elastic bandage* extending from beneath the chin to some form of headcap represents the simplest method of securing this effect, but it requires frequent adjustments and the action is

therefore not continuous. A transverse wire or pin through the symphysis, which is connected to a headcap through vertical rods may be used. In these as in all upward traction technics, care must be taken not to produce telescoping of the face by excessive upward force. Judgment must be used in deciding at what height the maxilla should be held.

(2) *Federspiel's* method provides for upward support of the maxilla by stainless steel wires which extend from a headcap through the cheeks to an arch bar on the upper or lower teeth.



FIG. 198 Federspiel's method of craniomaxillary fixation (Erich and Austin, *Traumatic Injuries of Facial Bones*, courtesy of W B Saunders Company)

(3) Direct skeletal fixation (internal wire fixation) after the method of *Adams* may be highly recommended as it frees the patient from wearing cumbersome, uncomfortable, or embarrassing external devices. Dingman and Hayward have recently re-emphasized the advantages of this method for caring for multiple upper facial fractures as well as for those of the mandible. The principle may be used to secure stabilization of a floating maxilla by running

stainless steel wires from an upper or lower arch bar up through the tissues to drill holes made in the lateral or inferior orbital border. Those wires which are completely buried in the tissues are left in place permanently, while those which enter the oral cavity must of course be removed at the end of the fixation period.

The *nasal bones* are fractured more frequently than any of the other facial bones, according to Blair and Ivy, and usually represent the sole fracture. While treatment does not lie within the field of

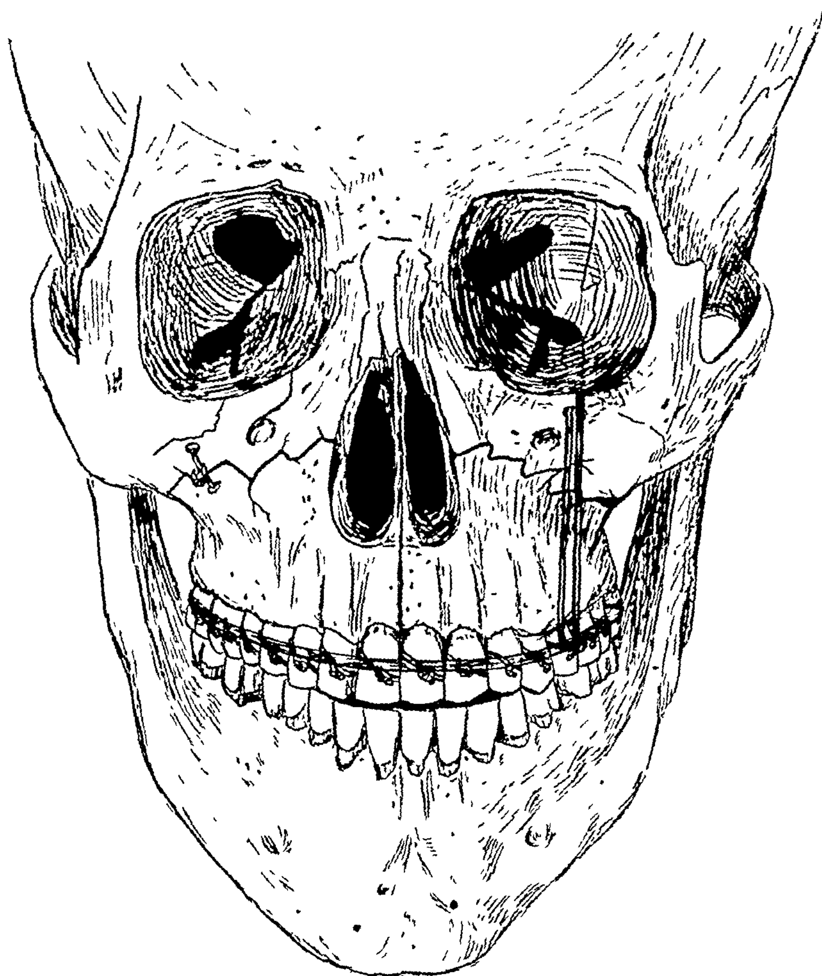
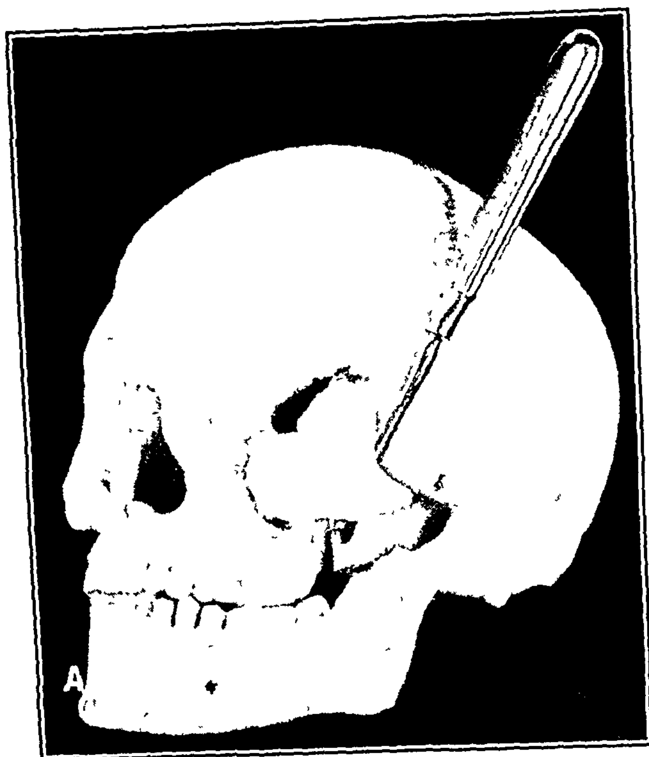


FIG 199 Two applications of Adams' method of internal wire fixation for fracture of the maxilla

dentistry, it may be said that early reduction by elevation and manipulation, followed by packing of the nose, is the usual method of management.

Fractures of the *malar bone* are usually of the depressed or inwardly displaced type because most blows which injure this portion of the face come from above or in front of the patient. The block-like bone usually remains intact but its frail buttresses give way under the force of impact. The attachments are three in number.



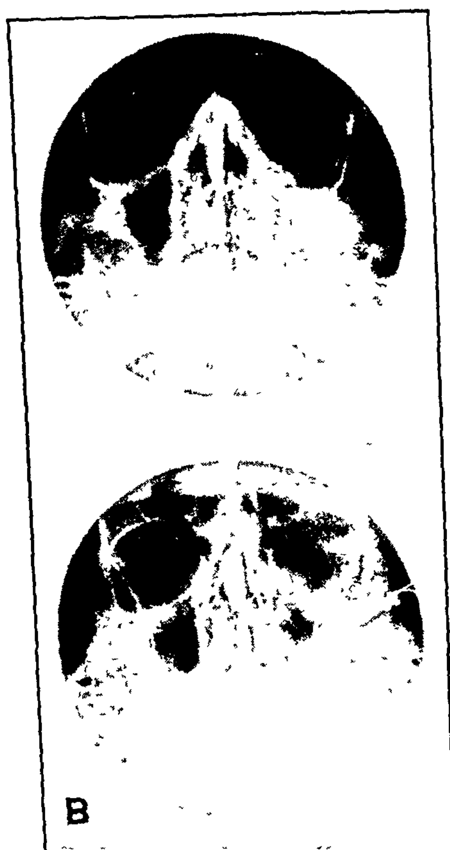


FIG 200 *A*, Gillies method of raising a depressed fracture of the malar bone (Erich and Austin, *Traumatic Injuries of Facial Bones*, courtesy of W. B. Saunders Company.) *B*, Old fracture of malar bone reduced and fixed by Vitallium screw and held in position by traction to a headcap. (Case of Dr. M. L. Westerberg.)

zygomatico-frontal, zygomatico-temporal, and zygomatico-maxillary. Separation or buckling of all suture lines is always present whenever the malar bone itself is displaced from its normal position. The most important points of clinical interest are the invariable presence of bleeding into the antrum, frequent impingement on the coronoid process of the mandible, diplopia, and flatness of the cheek after edema has subsided.

Treatment of depressed fractures of the malar bone should be at the earliest possible date due to the strong tendency for fibrous union to form rapidly. The bone may be grasped with a towel clamp or tenaculum and forcibly raised to its normal position, or elevated by the Gillies approach through the temporal region, or elevated from an intra-oral approach wherein the tuberosity of the maxilla becomes the fulcrum. No fixation is required for freshly injured cases as a rule. In comminuted cases and those where reduction is performed long after the accident, it may be necessary to enter the antrum, raise the fragments with instruments or finger tip, and hold them in position by packing firmly with a long strip of iodoform gauze, which is left in place for two weeks. In some cases outward traction is achieved by placing an external screw into the bone and arranging wire or rubber band traction to an extension arm of a plaster headcap.

Post-fixation Care of Jaw Fractures. In the usual case, fractures of the mandible which have been well reduced and securely stabilized will heal in four to six weeks. Maxillary and malar fractures often have functional union in two to three weeks. The criterion for healing is lack of mobility at the fracture site when digital manipulation is attempted. Radiographic evidence is of no value for determining when union has occurred as fracture lines will often be visible for many months after the development of solid bony union. In order to release the patient from intermaxillary fixation at the earliest possible date after union has occurred, it is customary to cut the tie wires at the end of three weeks and manipulate to see whether solid bony union is present. If it is not, the tie wires are replaced for another week, when the process is repeated. When manipulation fails to reveal abnormal mobility the patient is dismissed and asked to return in two or three days. If examination then discloses that no false motion has recurred, all of the basic wiring may be removed. The occlusion of the teeth should be carefully checked, and any discrepancies corrected by grinding. General dental care, consisting of prophylaxis, restoration of caries, and replacement of teeth lost in the accident should be done at an early date.

Feeding of jaw fracture patients whose teeth are wired together presents less of a problem than is commonly believed. When all teeth are present the nourishment must be entirely liquid or, if semisolid, should contain no fibrous residue. However, it is possible to provide a daily intake of 2500 to 3000 calories if the subject will cooperate and take frequent feedings with an adequate variety.

Milk, cream, puréed soups, eggs, and fruit and vegetable juices constitute the essentials of the full liquid diet. Something should be taken every two or three hours, to minimize hunger pangs. If some anterior teeth are missing, food of larger particle size can be introduced and the patient can enjoy a wider variety of food items. One of the liquid multiple vitamin preparations should be prescribed in the full therapeutic dose. For the patient who is hospitalized iced eggnog, milk shake, or Varco liquid diet should be kept at the bedside twenty-four hours a day. The Varco (number 2) diet is made up of 6 whole eggs, 2 egg whites, 120 grams of skim milk powder, 300 grams of sucrose or lactose, 1000 grams of skim milk, and 5 grams of salt. This makes 1500 cc. with a total of 2,428 calories.

Henny and Barron have called attention to the newer very fine caliber polyethylene tubings as a means of giving continuous feedings to seriously injured mouth and jaw cases. A small pump delivers the desired quantity of nourishment at a constant rate. Nearly any type of food may be liquefied in any of the various high speed food mixers, then strained, and taken by drinking tube or nasal tube.[31]

Scrupulous *cleanliness* of the exposed surfaces of teeth and wires should be maintained by brushing with a child's toothbrush at least twice a day, and preferably after every feeding.

Inspection and any necessary *adjustment of wires and elastics* should be done at frequent intervals, to maintain the efficiency of the fixation and to remove irritations which may develop from ends of the wires. Even though all wires are always twisted in the same direction (to the right) repeated tightening will lead to breakage. It is not necessary to have them so tight that no active movement by the patient is possible, though this should be kept to a minimum. Some authorities feel that very slight movement favors prompt healing.

Infection is infrequent during the healing period of jaw fractures providing that doubtful teeth and loose bone fragments were removed at the time of primary treatment. If an abscess develops the treatment should follow the same plan used for any jaw infection. If it is necessary to open the mouth in order to extract a tooth or lance an abscess, intermaxillary fixation should be resumed as soon as possible after completion of the intra-oral treatment.

Asphyxia due to vomiting while the teeth are wired shut, particularly during sea, air, or ambulance transportation, is unlikely, but in the interests of safety, tie wires should be replaced by rubber bands when travel is necessary. The patient should be provided with a pair of scissors with which to cut the rubber bands in case of an emergency.

Delayed union or *nonunion* may result from lack of apposition of bone ends due to loss of substance or interposition of soft tissue, or may be caused by a foreign body or a tooth in the line of fracture. Systemic diseases such as syphilis, diabetes, or anemia may be a

zygomatico-frontal, zygomatico-temporal, and zygomatico-maxillary. Separation or buckling of all suture lines is always present whenever the malar bone itself is displaced from its normal position. The most important points of clinical interest are the invariable presence of bleeding into the antrum, frequent impingement on the coronoid process of the mandible, diplopia, and flatness of the cheek after edema has subsided.

Treatment of depressed fractures of the malar bone should be at the earliest possible date due to the strong tendency for fibrous union to form rapidly. The bone may be grasped with a towel clamp or tenaculum and forcibly raised to its normal position, or elevated by the Gillies approach through the temporal region, or elevated from an intra-oral approach wherein the tuberosity of the maxilla becomes the fulcrum. No fixation is required for freshly injured cases as a rule. In comminuted cases and those where reduction is performed long after the accident, it may be necessary to enter the antrum, raise the fragments with instruments or finger tip, and hold them in position by packing firmly with a long strip of iodoform gauze, which is left in place for two weeks. In some cases outward traction is achieved by placing an external screw into the bone and arranging wire or rubber band traction to an extension arm of a plaster headcap.

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Hospitalized patients should be seen at least once daily, oftener if on the critical list. Daily progress notes should be written in ink, in the proper place in the chart. They should record information that does not already appear in the nurse's notes or laboratory report form.

The patient's requirements for analgesics, hypnotics, antibiotics, fluids, special nourishment, and vitamins should be anticipated before the need becomes urgent. Dressing changes should be done at proper intervals, but it is unwise to lift up the edge of dressings with nonsterile hands just to look at an incision, unless there is some purpose in mind.

Except in military situations the patient should be discharged from the hospital at the earliest date on which the temperature is normal and everything is progressing well. Measures such as radiographs, blood counts, dressing changes, and wire adjustments can be done satisfactorily on an out-patient basis.

If the patient who is convalescing from injuries develops any obscure complaint that cannot be readily explained, consultation with the appropriate medical or dental authority should be secured.

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factor. When the cause is local, bone grafting may eventually be required to achieve healing. Systemic causes should be cared for by the appropriate medical treatment.

Coincidental Injuries of Other Parts of the Body

The care of a patient with multiple body injuries requires close teamwork between all personnel who are to render care. In order that the best interests of the patient be served, it is desirable for one individual to assume responsibility for the total care of the patient. As this will inevitably be a physician, the dentist may chafe at finding himself in a somewhat minor role. The situation has its advantages as well as disadvantages, however, for he may concentrate on the technical problems at hand and refer to the medical attendant all matters pertaining to general care, insurance forms, talking with relatives, and so on.

Ideal treatment of face and jaw injuries may be difficult to achieve because of the inconvenience occasioned by the treatment measures being used to care for injuries of other parts of the body. Patients with fractures of the extremities will often be placed in traction in a Balkan frame, making it necessary to do difficult intra-oral procedures while the patient is in bed. Intracranial injury may preclude any manipulative procedures on the jaws for many days or weeks, making it impossible to secure the best result because of tardy reduction and fixation of the fractured jaw bones. Prior to the days of chemotherapy no one would think of manipulating a floating maxilla in the presence of spinal fluid rhinorrhea. Many authorities have a more liberal view now on this point. Actually, raising and stabilizing the displaced mass of bone has been known to hasten healing of the dural tear in some cases.

The dentist must always resign himself to some inconvenience when treating injury cases, and this is particularly true when multiple injuries are present. An injured patient may be taken immediately to the operating room after admission to the hospital and placed under general anesthesia for the arrest of hemorrhage, care of abdominal injuries, or treatment of fractured extremities. This may be an excellent opportunity for the dentist to perform at least some of the necessary oral surgical care which will have to be done sooner or later. As these sessions are often at night, the dentist may lose sleep in order to take advantage of this opportunity to get his treatment under way at the earliest possible time.

General Care of the Convalescent Patient

When the injured patient's wounds have received the necessary surgical care and the fractures have been reduced and fixed, the needs of the postoperative period should be given careful thought.

It has been pointed out in an earlier chapter that every time a dentist sees a patient he should perform a miniature history, physical examination, and review of the laboratory and radiographic data.

12

Infections

INTRODUCTION

VOCABULARY OF TERMS*

Toxin. Any poisonous substance of microbic, vegetable, or animal origin.

Infection. Invasion of the tissues of the body by pathogenic organisms in such a way that injury followed by reactive phenomena results

Inflammation. The condition into which tissues enter as a reaction to injury.

Abscess. A localized collection of pus in a cavity formed by the disintegration of tissues.

Cellulitis. Inflammation of cellular tissue; especially purulent inflammation of the loose subcutaneous tissue.

Ulcer. An open sore other than a wound; a loss of substance on a cutaneous or mucous surface, causing gradual disintegration and necrosis of the tissues.

Gangrene. Anemic necrosis of tissue combined, usually, with invasion by saprophytic organisms.

Necrosis. Death of a circumscribed portion of tissue

Sinus. (One meaning) A suppurating channel or fistula

Fistula. A deep, sinuous ulcer, often leading to an internal hollow organ

Resistance. (One meaning.) The more or less complete insusceptibility of an individual to various noxious agents such as poisons, toxins, irritants, etc.

Antibody. A specific substance produced by and in an animal as a reaction to the presence of an antigen and which reacts specifically with an antigen in some observable way. Antibodies produce specific effects on or with their antigens, such as flocculation, lysis, inactivation, etc. The antibodies include amboceptors, agglutinins, antienzymes, antitoxins, bacteriolysins, cytotoxins, hemolysins, opsonins, and precipitins.

Bacteremia. The presence of bacteria in the blood.

Septicemia. A morbid condition due to the presence of pathogenic bacteria and their associated poisons in the blood It is accompanied by chills, profuse sweat, and irregularly remittent fever and great prostration (The bacteria are growing and multiplying in the blood)

Pyemia. A general septicemia in which secondary foci of suppuration occur and multiple abscesses are formed

Focal Infection. Infection in which bacteria exist in circumscribed areas or foci in certain tissues, and from there are sent out into the blood stream.

Osteitis. Inflammation of a bone, inflammation of the haversian spaces, canals, and their branches, and generally of the medullary cavity.

* All definitions are from Dorland, W A N. *The American Illustrated Medical Dictionary*, 22nd ed., Philadelphia, W B. Saunders Co , 1951.

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Fig. 201. Phagocytosis of staphylococci by polymorphonuclear leukocytes. (Bell's *Textbook of Pathology*)

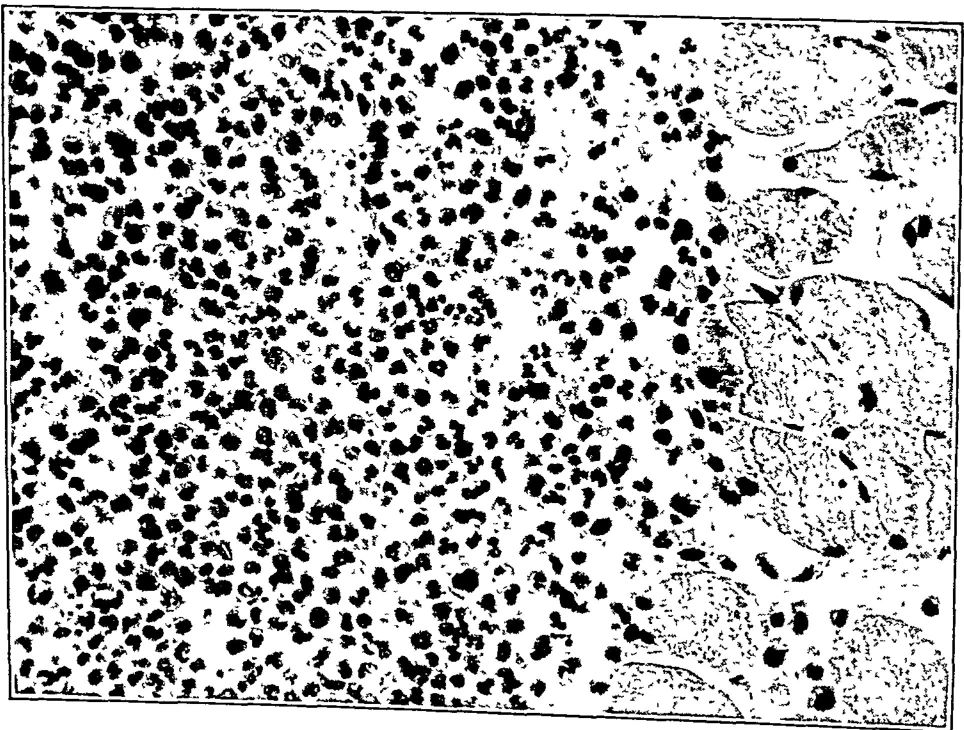


Fig 202 Abscess of muscle Note many polymorphonuclear leukocytes and a few macrophages (Bell's *Textbook of Pathology*)

Osteomyelitis. Inflammation of bone caused by a pyogenic organism It may remain localized or it may spread through the bone to involve the marrow, cortex, cancellous tissue, and periosteum.

Osteoradionecrosis. Necrosis of bone following irradiation.

Chemotherapy. The treatment of disease by administering chemicals which affect the causative organism unfavorably but do not injure the patient

Antibiotic. 1 Destructive of life 2 Pertaining to or characterized by antibiosis The term antibiotics is given to antibacterial substances of biologic origin. They are derived from bacteria, actinomyces, molds, and fungi, or natural substances other than micro-organisms

Pathogenesis

The similarity of infections to traumatic injuries in their effect on tissue has already been pointed out. Wounds often become infected, and infections produce injury of tissues. It is therefore inevitable that there is considerable overlapping in the discussions of the pathogenesis, morbid physiology, and treatment of these two categories of oral surgical problems. Whenever there has been injury to tissue cells, the successful outcome of treatment is reached when healing and repair have been achieved.

The clinician must discriminate between two general effects of any infectious process: (*a*) *invasion*, and (*b*) the *simple suppurative decomposition* of necrotic tissue. Both may be present at the same time. Therapy may be incomplete if either process is overlooked

Microscopic Changes in Inflammation Due to Infection

The most significant difference in the appearance of the inflammatory exudate of infection over that of traumatic injury is the presence of bacteria, and the polymorphonuclear leukocytes and macrophages which arrive to ingest them. If phagocytosis of all bacteria present is successfully accomplished the phenomenon is spoken of as *resolution*, and the situation reverts to essentially the same status as that of a clean wound, with repair proceeding promptly.

If, on the other hand, the leukocytes are unable to cope with the bacterial invasion, the infection continues to *spread*, either locally, or through the lymphatics and blood stream.

If neither resolution nor further immediate invasion occur the infection becomes *localized* or *walled off*. In such a case there will be a central pool of liquid necrotic débris, dead and live bacteria, and dead leukocytes; this liquid pus will be surrounded by a protective wall of lymphocytes and young fibrous connective tissue. This *abscess* may, in favorable instances, gradually be resolved by the elimination of the pus through action of the repair elements of the body, but far more frequently pressure will continue to develop due to continued low grade bacterial action, and the abscess will extend into other tissue areas by following the line of least resistance. When it nearly breaks through a skin or mucosal surface it is spoken of as *pointing*.

dental disease is very proper in its place, and serves well to label the various clinical pictures so that they may be catalogued and studied. However, until the etiological agent of any disease is known treatment remains empirical.

Prior to the days of the bacteriological study of lung diseases, pneumonias were grouped into just two types: lobar and bronchopneumonia. This morphological grouping of cases was of little help in developing specific treatment measures. When it became possible to identify causative organisms it was found there were not two but scores of different pneumonias, each with a specific strain of bacteria or virus as its cause.

The introduction of specific serum therapy was only a matter of time. Then penicillin and the sulfonamides took their important places in the arrangement of specific antibacterial therapy for each pneumonia, according to its etiological agent. Vital statistics tell the story of success. In the State of Minnesota there were 1,989 pneumonia deaths in 1930, and only 796 in 1950—a reduction of 60 per cent for the period![1]

The same principle was applied to diseases of the intestine, where treatment was formerly entirely symptomatic, since diagnoses were based only on clinical findings rather than on the etiological agent. Isolation on the pathogens causing typhoid fever, tuberculous enteritis, the dysenteries, and the host of other intestinal diseases paved the way for highly effective preventive and treatment measures.

Virtually all known pathogenic organisms have been recovered from phlegmons and abscesses about the teeth, jaws, and face. Certain organisms are present far more commonly, however. Streptococci and staphylococci of various types outnumber other organisms by a wide margin. Each bacterial strain tends to produce its own characteristic symptoms.

Identification of the causative organisms is a task for the laboratory, but procuring the specimen devolves upon the clinician. Organisms may be obtained by aspiration with a syringe and needle, or from the outflowing pus at the time of surgical drainage, or, in appropriate instances, from the blood stream. Isolation of the organism is often difficult and sometimes impossible; fortunately it is not always necessary.

Since it is the bacterial toxins that determine whether the patient will become ill, how sick he will get, and whether he will recover at all, antibacterial therapy is one of the most effective weapons in present day treatment of severe infections.

Treatment Directed Against the Bacteria

1. *Penicillin.* It is most fortunate that the organisms usually responsible for jaw infections fall into the gram-positive category, and that penicillin happens to be most active against just this group. Had it so happened that penicillin was effective against only staphylococcus aureus, for example, the addition of this drug

LOCAL SIGNS OF INFLAMMATION DUE TO INFECTION

Although similar to the inflammation produced by traumatic injury, that resulting from infection is usually more severe, produces more local heat, feels harder when palpated, and tends to increase in severity with the passage of time. Soft areas indicate the presence of pus. Because of the tendency of infections to spread, regional lymph nodes may be enlarged and tender.

SYSTEMIC EFFECTS OF INFECTION

The toxins produced by pathogenic organisms invariably produce certain bodily effects which are present to a greater or lesser degree in every case of infection. They are:

1. Fever, and occasionally chills.
2. Leukocytosis, or occasionally leukopenia.
3 Increase in the pulse rate.
4. Malaise, with aching through the muscles and joints, and restlessness.
5. Anorexia, or actual nausea and vomiting.
6. Anemia, particularly with hemolytic infections.

MECHANISM OF HEALING IN INFECTIONS

The method by which the body achieves healing of an infection is essentially the same as for wounds. Extremely small, mild infections heal in much the same way as an incised wound—by primary healing—though the term is seldom applied to infections. The more severe infections heal in the manner of a granulating wound. In fact, virtually all wounds which are healing by granulation contain a greater or lesser degree of infection, so that what has been said previously about the delayed healing of wounds may be applied to any chronic, granulomatous infection.

BASIC FACTORS IN INFECTIONS*

The problems of diagnosis and management of oral infections can be broken down into three main factors

1. The *bacteria* causing the disease.
2. The *tissues* in which the bacteria are growing.
3. The *resistance* of the patient.

All three factors are interwoven to form the pattern of each individual case of infection The diagnosis cannot be complete without due consideration for each of them. Each one presents unique treatment possibilities.

The Bacteria Causing the Disease

DIAGNOSTIC ASPECTS

There is a tendency in clinical practice to forget that infections, after all, are caused by bacteria. The morphological conception of

* The greater part of this section is based on material from the author's article, Oral infections of dental origin; present day management, courtesy of Northwest Dent, *31* 71, 1952.

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SYSTEMIC USE OF CHEMOTHERAPY IN DENTISTRY*

Diagnosis	*Drug*	*Form*	*Minimal Recommended Adult Dosage*	*Duration of Treatment*
prophylactic use cellulitis osteomyelitis pericoronitis Vincent's infection	penicillin	crystalline aqueous	50,000 units every 3 hours	For *prophylactic use*, administer the drug the day before, the day of, and the day after the operation.
		procaine precipitate	300,000 units daily	
		D B E D	600,000 units in single dose	
		oral crystalline	300,000 units every 4 hours	
		oral DBED	200,000 units twice daily	
	chlortetracycline	oral	250 mg every 4 hours	*Treatment* should be continued for two days after all symptoms have disappeared and after two days of normal temperature.
	oxytetracycline	oral	250 mg every 4 hours	
	erythromycin	oral	300 mg every 6 hours	
	sulfisoxazole	oral	4 grams initially, then 1 gram every 4 to 6 hours	

Commercial forms
Procaine precipitate Crysticillin, Duracillin, Wycillin, etc.
DBED Bicillin
Chlortetracycline· Aureomycin
Oxytetracycline Terramycin
Sulfisoxazole Gantrisin

* Modified from Zander, H A and Clark, H. B, Jr Antibiotic Therapy in Oral Surgery and Dentistry, Chapter 26 of Welch, H. *Principles and Practice of Antibiotic Therapy*, New York, Medical Encyclopedia, Inc, p 674, 1954.

to the therapeutic armamentarium would have been valuable, but further search would have had to be made for agents to combat the other common causes of dento-alveolar infections. The tremendous usefulness of penicillin in the field of oral infections is thus apparent. The cost of penicillin has become so moderate, the toxic features so nearly eliminated, that it is questionable whether one is ever justified in withholding it from any patient suffering from a severe infection caused by a penicillin-sensitive organism.

Penicillin, or any other specific antibiotic, aids the defenses of the body much as a torrential downpour assists men fighting a forest fire. In very grave infections the agent may truly be lifesaving. In moderate cases recovery is speeded and complications are reduced.

All methods of introducing the agent into the body or into the lesion possess merit. The important things are to get the substance to the bacteria as quickly as possible, and to give amounts adequate to cure the patient. The minimal recommended doses for penicillin and the other commonly used chemotherapeutic agents are given in the table on p. 321.

Whichever method of administration is being used, the patient's status should be critically appraised from day to day. If improvement is not apparent, after one or two days of therapy, and specimens of the organism have not yet been procured, this should be done and sensitivity tests performed to determine whether the same or a different antibiotic should be used from that point forward.

2. *Chlortetracycline and oxytetracycline* should be the dentist's second choice. They are so ranked because of greater expense and the tendency to produce gastro-intestinal symptoms, particularly diarrhea. The intestinal irritation is caused, in most instances, by an overgrowth of resistant strains of organisms such as monilia and staphylococci, which produces a severe enterocolitis much like that seen in acute food poisoning.

3. *Erythromycin* is another orally administered antibiotic which may be used in treating oral infections. It does not have as wide a spectrum as the tetracycline preparations, and hence is less inclined to produce gastro-intestinal symptoms. Organisms which are resistant to penicillin will sometimes be sensitive to erythromycin.

4. *Streptomycin* is highly effective against gram-negative organisms, the tubercle bacillus, and some gram-positive bacteria. It is given parenterally. The indiscriminate use of this preparation is to be discouraged because of its tendency to produce irreversible changes in the eighth nerve. However, Northrop has pointed out that these effects are seldom noticed before the tenth to fourteenth day of treatment, and are commoner with large doses.[2] One-half to 1.0 gram may be given daily for a few days, in indicated cases, with little hazard of deafness or vestibular disturbance.

5. The use of *sulfonamides* has again become more prevalent, after having been nearly abandoned at the time when the antibiotics became freely available. Their earlier disadvantage, the production of crystalluria, has been overcome to a large extent by

whenever found. The outflowing of purulent fluid physically removes thousands of bacteria, their toxins, and dead cells that have been liquefied. The release of pressure permits cellular and vascular elements of the body's defense mechanism to function more efficiently. Incision and drainage must be adequate when performed, as a certain measurable amount of trauma is inflicted by the act, which will tend to offset the good accomplished. Drainage should be dependent whenever possible; that is, it should tap the lowest point of the abscess cavity. Egress of pus which may be formed later should be provided for by leaving a strip of Penrose or rubber dam drain in the tract for several days. Hot moist applications, if the opening is on the skin, will help prevent closure by crusting.

The value of successful incision and drainage must be constantly kept in mind, and the clinician should seek opportunities to employ it. The turning point in any pyogenic infection is reached when pus can be discovered and allowed to escape to the outside. True fluctuation indicative of a pocket of pus may not be present if the fluid is deep. Aspiration by needle is a valuable means of learning whether suspected pus is really present, but should always be followed by adequate incision and drainage when the syringe yields pus. The methods of performing incision and drainage have been described in the chapter on surgical technic, p. 139.

2. *Removal of Dead Tissues or Organs.* (*a*) *Tooth Extraction.*—The extraction of the offending tooth is proper surgery, since it removes at once the cause of the infection, a foreign body, and an obstacle to drainage.[4] Trauma incident to extraction must be critically appraised, however, and where the operation would be lengthy and difficult it should be deferred until all acute inflammation has disappeared. Any removal of teeth in the presence of acute infection should be done under general anesthesia.

Krogh has proposed that tooth extraction should be performed at once in all cases of acute odontogenic infection. When immediate extraction was performed in 1,173 cases of pulpitis, only 12 cases required further treatment. In 854 cases of extraction for acutely abscessed teeth only 30 showed complications or required further treatment. When immediate tooth removal was performed in 599 cases of pericoronitis only 36 required further treatment. In his combined series there was a total of 78 complications, less than 3 per cent, most of them minor. No cases of osteomyelitis or septicemia resulted and there were no deaths. He concluded that extraction is the treatment of choice for cases of acute abscess or pericoronitis.[5]

(*b*) *Removal of Dead Bone.* Infections are not static but rather dynamic in nature. They are constantly tending to become better or worse, depending upon the momentary balance of all three factors. When the tide of battle has turned in favor of the patient, repair proceeds at a more rapid rate. Débris, both liquid and solid, are systematically removed by phagocytes acting as scavengers. Removal of necrotic bone represents a far slower and more difficult task, however, and bony tissue which has lost its vitality during

the custom of administering small doses of several different sulfonamides, so that a concentrated solution of any one drug is less likely to develop in the kidney tubules. Perhaps the best of the sulfonamides to use alone is sulfisoxazole (Gantrisin, Roche) which seldom produces crystalluria even though the fluid intake is not forced and alkalis are not administered.

6. *Precautions with Antibiotics.* The use of antibiotics is not without certain dangers and general objections. It is unwise to use them promiscuously for minor, well-localized infections in normal individuals. With penicillin, reactions of the urticaria, skin rash, or angioneurotic edema type may occur, and fatalities from these effects have been reported. Resistant strains of organisms may be formed while antibiotic therapy is in progress, creating a more complicated treatment problem in the present or future diseases. The item of expense is always a consideration. Nonetheless, the important place of these antibacterial substances in the treatment of oral infections cannot be overemphasized.

The Tissues in Which the Bacteria Are Growing

Diagnostic Aspects

The tissues of the mouth and jaws vary widely as to toughness, hardness, looseness, and also as to their defensive power against a bacterial invader. Bone is one of the feebler defenders and is slow to repair itself when injured. Muscle and fascia, on the other hand, react vigorously with strong defenses to most infections, and are repaired promptly with scar tissue. The dental pulp, due to its confined position and precarious blood supply through the apical foramen, can withstand very little insult from infection, and the necrosis of this organ is the usual outcome.[3]

The laws of physics apply to all phenomena seen in mouth and jaw infections. Pus locked under the periosteum in a progressive lesion will produce excruciating pain. When at length it bursts through this tough, parchment-like sheath of the jaw bone, there is immediate relief as the fluid escapes into the looser substance of muscle and fatty tissue. When capable of responding to gravity, liquid pus will flow downhill. When confined in a sealed compartment, pressure will continue to mount until incision or bursting occurs. If the space has an exit, pus will be squeezed out through it into contiguous regions. An example of the latter situation is the carotid sheath, whence pus may travel downward without meeting any barrier, finally reaching the mediastinum, with dire consequences.

Treatment Directed at the Tissues in Which the Bacteria Grow

Measures discussed under this heading include (1) the release of liquid necrotic débris, and (2) the removal of dead tissue or organs.

1. *Incision and Drainage.* Pus under pressure *must* be drained

bacterial metabolism. Resistance is the one quality which, acting alone, may successfully overcome an infection.

TREATMENT MEASURES DESIGNED TO INCREASE THE PATIENT'S RESISTANCE

These should emphasize the scientific rather than the controversial. Named in order of their importance they are:

1. *Rest*, of the entire body, and of the affected part by splinting. Sedatives and hypnotics should be used unhesitatingly to achieve it.
2. *Adequate Fluid Intake.* With each degree rise in temperature the fluid needs of the body increase sharply. Tissue physiology demands water to wage an effective defense. If the patient is unwilling or unable to take fluids by mouth, the intravenous and subcutaneous routes should be used.
3. *Adequate Nourishment.* When mouth and jaws are sore and swollen, patients are prone to cease eating. After one or two days of fasting, appetite disappears. Tissues are deprived of proteins, carbohydrates, vitamins, and the mineral salts, with a resulting decrease in bodily defenses. Liquid and semisolid foods which are high in these elements must therefore be *forced* on the patient in frequent, small feedings, even against his objections. If this is impossible, tube or intravenous feeding must be used.
4. *Blood transfusion*, if the hemoglobin is depleted. The patient needs the oxygen carrying capacity of a full quota of red cells as well as the other vital elements of whole blood.
5. *Analgesics* for the relief of pain. The symptom of pain may be an alarm to signal the need for surgical drainage or some other measure, but when all necessary treatment is under way, the patient is entitled to the tranquility available from analgesic drugs.
6. *Physical therapy* such as heat, cold, and hydrotherapy. Heat increases the inflammatory process to a certain extent, while cold retards it at first, then apparently has much the same effect as heat. Neither should be used to excess, as burning or freezing have been known to occur. It may be rather arbitrarily stated that cold in any form should be avoided in infections contiguous to bone, while hot mouth washes or irrigations may be used to an unlimited extent within the mouth in any condition. In the past, too much attention and significance have probably been attached to physical therapy in treating phlegmons of the face and jaws. Valuable time may be wasted arranging and rendering these services, when antibiotics or chemotherapy would be far more specifically helpful. First things should be done first.
7. *Laxatives and Cathartics.* This feature has also been too much stressed in the past. Valuable fluids may be lost through excessive purging and the patient deprived of needed rest. A cathartic should by no means be a routine order on all patients suffering from jaw infections.

Measures used to augment the patient's resistance in any given case should be selected on their merits. First things must be put

the conflagration will usually have to be cast off *en masse* as a sequestrum. Bone is endowed with much feebler defensive powers than soft tissue. For this reason it is essential to determine during the active stage of disease whether bone is involved in the bacterial invasion. The presence of excruciating pain, relieved only by heavy doses of morphine, the presence of a very large collection or outpouring of pus, give strong indication that massive bone infection is in progress. Wide open drainage is imperative under such circumstances, to check the burrowing effect of pus under pressure.

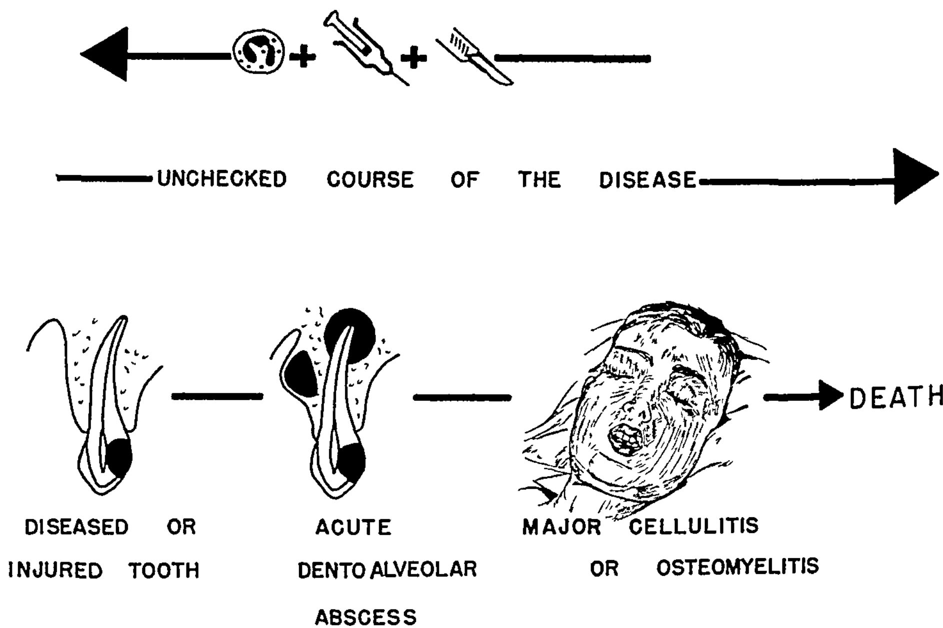


Fig 203 Diagram illustrating how each of the three types of treatment measures may act to reverse the course of an acute infection (Clark, courtesy of North-West Dent.)

The Resistance of the Patient

Diagnostic Aspects

This all important factor is what keeps the body alive at all. In conditions such as noma and agranulocytosis death ensues promptly unless heroic treatment can hold the line until the patient's resistance can rally and resume its essential functions. Patients who are severely fatigued, malnourished, or suffering from intercurrent illness are fertile soil for pneumonia, tuberculosis, or for dento-alveolar infections. A definite distinction should be made between local and general resistance. The former refers to the walling off process seen in a localized abscess. The latter includes considerations of antibodies, opsonins, enzym

8. If you were given an injection of penicillin or tablets of one of the sulfa drugs it was to help your body fight the infection. It is also a valuable protection against spread of the infection at the time your tooth will be extracted.

9. If the infection breaks and drains into the mouth there should be marked improvement. If this does not happen spontaneously it may be necessary for us to drain the abscess by making an incision. This is usually done under general anesthesia.

10. If the extraction of your tooth was delayed it was for the purpose of safety, so that your resistance could be built up. It is often best to remove acutely infected teeth under general anesthesia. This work is done by appointment, first thing in the morning. Local anesthesia does not work well on acutely infected teeth and jaws.

11. If you have been given an appointment to have a general anesthetic be sure you *do not eat or drink anything for at least six hours* before the operation. This is very important. Please keep your appointment promptly as several people are needed to properly care for you and their time is limited.

* * * * *

Combination Therapy. The dentist of today is immensely fortunate in possessing weapons for a triple attack on oral infections of dental origin. A severe fulminating disease will impel him to bring all three into play at once—antibiotics, incision and drainage, and measures to aid the patient's resistance. When an infection is mild, he may elect to hold some agencies in reserve and watch the effect of one or two measures as a trial.

The use of chemotherapy changes the course of infections markedly from the old textbook pictures. Under the powerful effect of antibiotic therapy a cellulitis or presumptive abscess may completely resolve and disappear, much to the confusion of the medical or dental attendant who was patiently awaiting the appropriate moment to incise and drain! On the other hand, antibiotics may "mask" serious changes which are simply suppressed by heavy antibacterial treatment. In such a case the infection will flare up anew when chemotherapy is discontinued.

Each time the patient is seen a brief history, examination, and laboratory review should be done. The dentist must study carefully by eye and finger tips the progress of all infiltrating and expanding inflammatory processes, to determine when a pocket of pus has developed. When true fluctuation occurs, the performance of incision and drainage is imperative. But since in most deeply situated abscesses true fluctuation never appears, the decision to drain must be made by careful appraisal of all other physical findings

The outline of therapy by the informed practitioner is therefore different for every case; but always he wields potent effective weapons with firmness and resolve in spite of the obstacles that may beset his path. He keeps in mind the tendency of disease states to

first. Patients often attempt to persuade their dentist to let them take a trip or continue working when rest is urgently needed. They may complain of lack of appetite and attempt to fast at the very time when the reserve of their body's proteins, minerals, and vitamins is critically low. The dentist must make sure that his orders regarding these important measures are being carried out.

CLINICAL APPLICATION OF THE BASIC FACTORS

Instructions for Home Care. These may be given to patients in the form of a mimeographed or printed leaflet. Any general items which do not apply to a specific case may be crossed out. The text of the leaflet which is used at the University of Minnesota School of Dentistry is as follows:

General Instructions to Patients With Acute Infections of the Teeth and Jaws

1. Unless otherwise directed, rinse the mouth vigorously every hour, using up a full glass of hot water, in which a half teaspoonful of salt and a half teaspoonful of soda have been dissolved. Continue this every hour on-the-hour, except when sleeping. If you cannot get a supply of salt and soda, *use the hot water* anyway.
2. Hot irrigations in the mouth are even better than the rinsing. Fill an enema or irrigation bag with hot water, sit down in front of the sink or wash bowl with the head forward and mouth open, then let the hot water run out of the nozzle, shooting a stream against the sore or swollen gums. This carries heat to the part and also washes away food particles and débris. Do this every hour if possible.
3. Do not put any ice on the face. Do not use dry heat. Bath towels dipped in hot water and then wrung out as dry as possible may be used if the doctor says your case needs it. They should be applied for fifteen minutes out of each hour.
4. You may have been given tablets to control pain, and capsules for sleep. Do not overdose. Follow the directions on the envelopes.
5. It is very important that you drink lots of fluids, at least 8 to 12 glasses daily. Coffee, tea, ginger ale, etc. may be counted as water.
6. Keep taking nourishment. Try not to skip a single meal. The meal need not be large but something should be taken every three or four hours while awake. Your body needs the components of wholesome food to help fight the infection. Heavy soup, milk toast, soft boiled eggs, milk, cream, and well-cooked cereal are good. You will feel better, have more strength, less pain, and heal faster, if you continue to eat.
7. *Rest is very important.* Go home and go to bed if possible. The infection from which you are suffering probably occurred at this time because your resistance was low. Rest is the best way to help the body build up resistance.

6. Oral infections are dynamic processes and may progress in a favorable or unfavorable direction rapidly, depending upon the balance of the three factors.

7. Postinfection sequellæ must be anticipated and dealt with promptly.

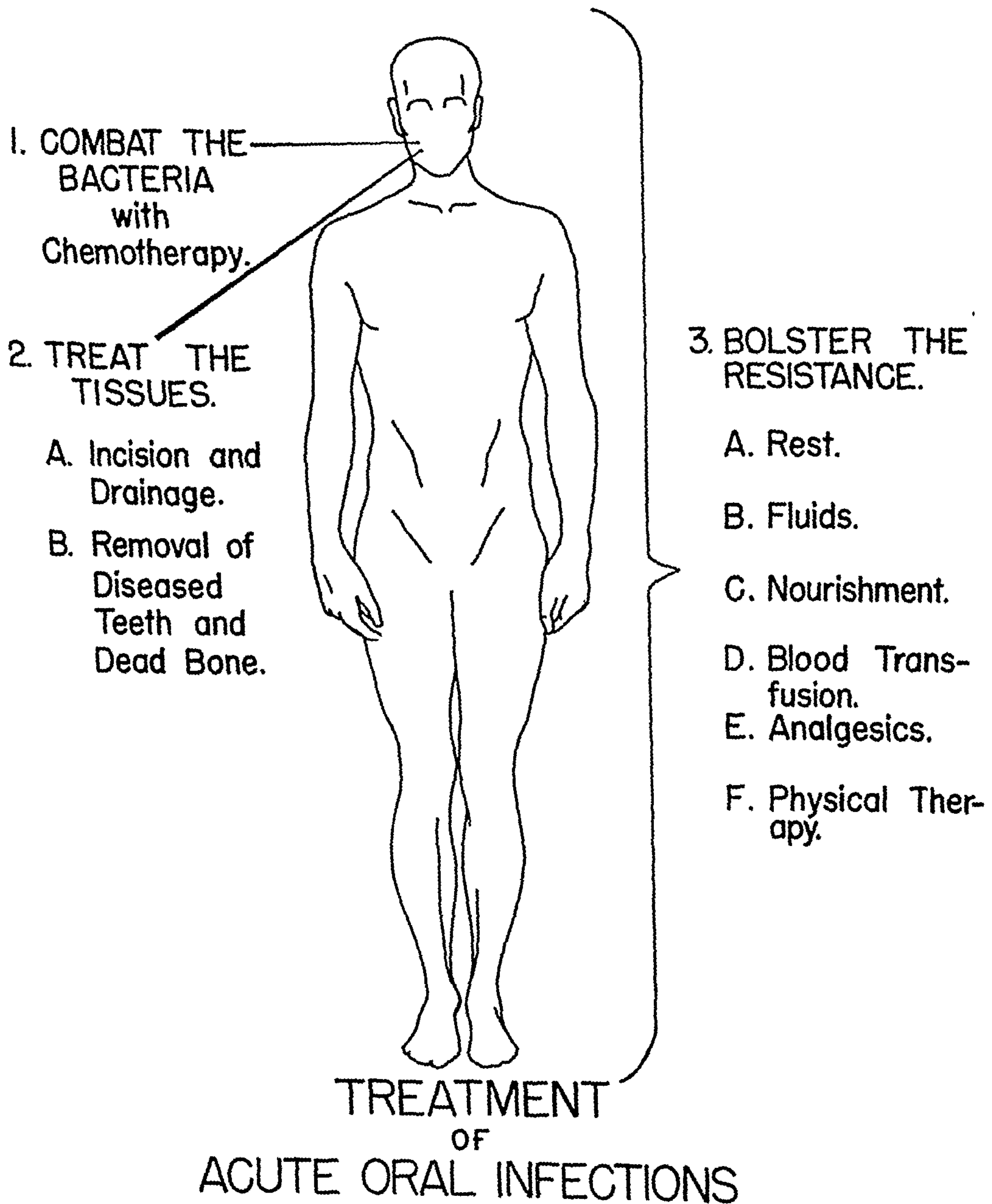


Fig. 204

Antibiotic Prophylaxis Against Infection*

Implantation in Tooth Sockets. Antibiotics have been used widely for prophylactic purposes in oral surgery upon normal

* Parts of this section are from: Welch, H.: *Principles and Practice of Antibiotic Therapy*, New York, Medical Encyclopedia, Inc., 1954, Chapter 26; *Antibiotic Therapy in Oral Surgery and Dentistry*, by Zander, H. A., and Clark, H. B., Jr.

constantly change rather than to run clear-cut clinical courses. He is ever on the alert for adverse developments, and responds quickly with effective specific measures.

Danger Signs. The following is a partial list of unfavorable situations which demand prompt investigation and vigorous treatment

A. Pus exuding from about the necks of several teeth.

B. Severe intractable pain, relieved only by heavy doses of morphine.

C. Extremely large swellings, particularly if increasing in any direction.

D. Extension across the mid-line by a swelling previously unilateral.

E. Progressive rise in temperature over a period of days.

F. Development of any new feature such as chills, vomiting, pain in the chest, cough, difficult breathing, cyanosis, or convulsions.

Postinfection Period. When the fire of an acute infection has at length burned itself out, the attendant's guard must still be kept up. In addition to sequellæ such as small bony sequestra which may require removal, or a previously overlooked pool of pus requiring drainage, there may be anemia, avitaminosis, or hypoproteinemia due to the restricted food intake and altered physiology existing during the period of illness. In the state of lowered resistance the patient represents a ready host to pneumonia and other infectious diseases. The dentist must be alert to the likelihood that previously sound teeth may have lost their vitality or sustained irreparable damage to the periodontium during the course of a violent suppurative episode in their neighborhood. Such teeth will doubtless require removal, as they constitute foreign bodies from that point on.

Summary. The basic factors in oral infections may be summarized as follows

1. Oral infections of dental origin consist of three prime elements: the bacteria causing the disease, the tissues in which they are growing, and the patient's resistance. Each element presents important diagnostic features and unique treatment possibilities.

2. In severe infections bacteria should be attacked with specific chemotherapeutic agents. Success can be anticipated similar to that which has been achieved with pneumonias. Penicillin is the drug of choice in most oral infections, due to its potency over the group of organisms usually found in the mouth, and because of its moderate cost.

3. Mouth and jaw tissues differ widely in their physical structure and ability to withstand infection. Properly timed and executed incision and drainage takes all anatomical and hydrostatic factors into account. When successful it usually causes a dramatic change in the course of the disease.

4. Both local tissue resistance and that of the body as a whole are fundamentally the curative agencies in any disease.

5. The three treatment measures may be used singly or in combination. Overwhelming or rapidly progressing infections demand all three without delay.

jection. He further cautioned that if the indication for penicillin was urgent, parenteral administration would be needed in addition, weakening the argument for local injection.[24]

Systemic Administration. Antibiotics have been used extensively by the oral and parenteral routes for prophylaxis against postoperative infection in oral surgery. Here, too, the proven value of such practice is difficult to establish since the healing of oral surgical wounds in the absence of antibiotics is the general rule. Rapoport reported uneventful healing in 51 cases receiving aluminum penicillin by mouth.[25] Jacobs and Jacobs used oral aureomycin in 25 cases including removal of acutely infected impacted third molars and secured prompt healing in all. Diarrhea was encountered in 7 patients and nausea in 1, however.[26] Nathanson *et al.* used injected Bicillin 600,000 units in 150 cases of various oral surgical procedures, but supplemented it with aqueous crystalline penicillin when operating upon acute infections or complicated fractures. No statistics or controls were given.[27]

The employment of penicillin or one of the other antibiotics as an "umbrella" for virtually all cases of major maxillofacial surgery in the hospital has become universal practice. The impression of all observers is that the incidence of wound infection and osteomyelitis has been greatly reduced as a consequence, but comparative figures are scanty. The large number of reports of resections and bone grafts successfully accomplished in the presence of salivary contamination gives convincing evidence that the maintenance of an adequate blood level of a suitable antibiotic will nearly eliminate the possibility of infection, providing good surgical technic is employed.

MORPHOLOGICAL TYPES OF ORAL INFECTIONS

Local Chronic Infections

Chronic Periapical Abscess, Granuloma, or Cyst. These three conditions comprise the most frequently encountered example of chronic infection within the alveolar process (Fig. 2). It is not possible to distinguish between the three by radiographic examination, and it is likewise not possible to learn by this means whether live bacteria are present at the time of examination. Even though these lesions may be sterile for prolonged periods they are spoken of as infections, for at any time they may flare into an acute inflammatory process.

The analogy is somewhat like the situation with regard to pulmonary tuberculosis. When an open, caseating or suppurating tubercle is discharging organisms into the sputum the case is spoken of as "active." When the process subsides, and bacteria are no longer being discharged into the tracheobroncheal tree, it is spoken of as "arrested" or "closed." These terms do not specify whether the acid-fast bacilli have actually been killed or whether they are merely tightly walled off by heavy scar. For all practical purposes

subjects. Although the incidence of postoperative infections is small even when no antibiotics are used, extensive employment of these agents has been practiced in an effort to reduce complications and improve conditions for healing. Following clinical trial, Blumenthal,[6] Hitchin,[7] Scrivener and Schantz,[8] and Epstein[9] reported good results from the implantation of penicillin in tooth sockets in the form of tablets, ointment, or solution carried to place in Gelfoam. Roth reported similar results with aureomycin.[10] Studies using penicillin and a control series were done by Stone,[11] Garehime,[12] Gwinn *et al.*,[13] and Olech[14] with considerably less enthusiastic reports. Verbic found a statistically significant reduction in the amount of pain and swelling with the use of 50 milligram tablets of aureomycin as compared with a control group.[15] Epstein found that the use of a pellet containing 1 milligram of tyrothrycin in human thrombin resulted in more pain and swelling than occurred when no pellets were used.[16] Versnel implanted penicillin in extraction sockets of dogs and found histological evidence of the substance for two days and some delay in epithelialization of the wound as compared to untreated sockets.[17] Fleming and Fish found that penicillin greatly increased clotting time and clot retraction time *in vitro* in concentrations in excess of 170 units per cubic centimeter. As a consequence they advised against implantation of penicillin in wounds, recommending instead lavage with a solution containing not over 100 units per cubic centimeter and intramuscular penicillin in addition, when antibiotics were indicated.[18] Peter and Little felt this anticoagulant effect could be counteracted by thrombin in Gelfoam.[19] Holland and Tam placed 50,000 to 100,000 units of pure crystalline penicillin G in 274 sockets and control tablets of sterile lactose in 286. There was no statistically significant difference in the number of cases of osteitis in the two groups.[20] Alexander used Gelfoam saturated with a solution of bacitracin (1000 units per cubic centimeter) in procaine as a routine dressing in tooth extraction wounds in 1000 patients. He found the results gratifying and without complications.[21]

The evaluation of these reports would indicate that the use of antibiotics in oral surgical wounds may introduce complications along with the possible benefits. All writers stress that antibiotics cannot take the place of good surgery.

Local Injection. Local use of penicillin by injection into the tissues has been advocated by Nevin[22] as an outgrowth of work by Lovestedt[23] which showed that penicillin may be combined with some local anesthetics. A Monocaine-penicillin combination has been offered to the profession for use in areas of chronic infection. The fact that a high concentration of penicillin is produced in the tissues adjacent to the operative field by this means cannot be disputed, but the need for this therapy is difficult to prove. Mallett opposed this method of using penicillin with the feeling that an operator might be led to operate in acutely infected fields containing penicillin-resistant organisms which would be spread by the in-

jection. He further cautioned that if the indication for penicillin was urgent, parenteral administration would be needed in addition, weakening the argument for local injection.[24]

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the dentist may assume that pathogenic organisms are sealed off in a similar manner in painless periapical lesions on nonvital teeth. The resistance of the patient keeps them arrested or closed. One further analogy might be given, that of a volcano which may be extinct, smouldering, or actively erupting. A quiescent periapical

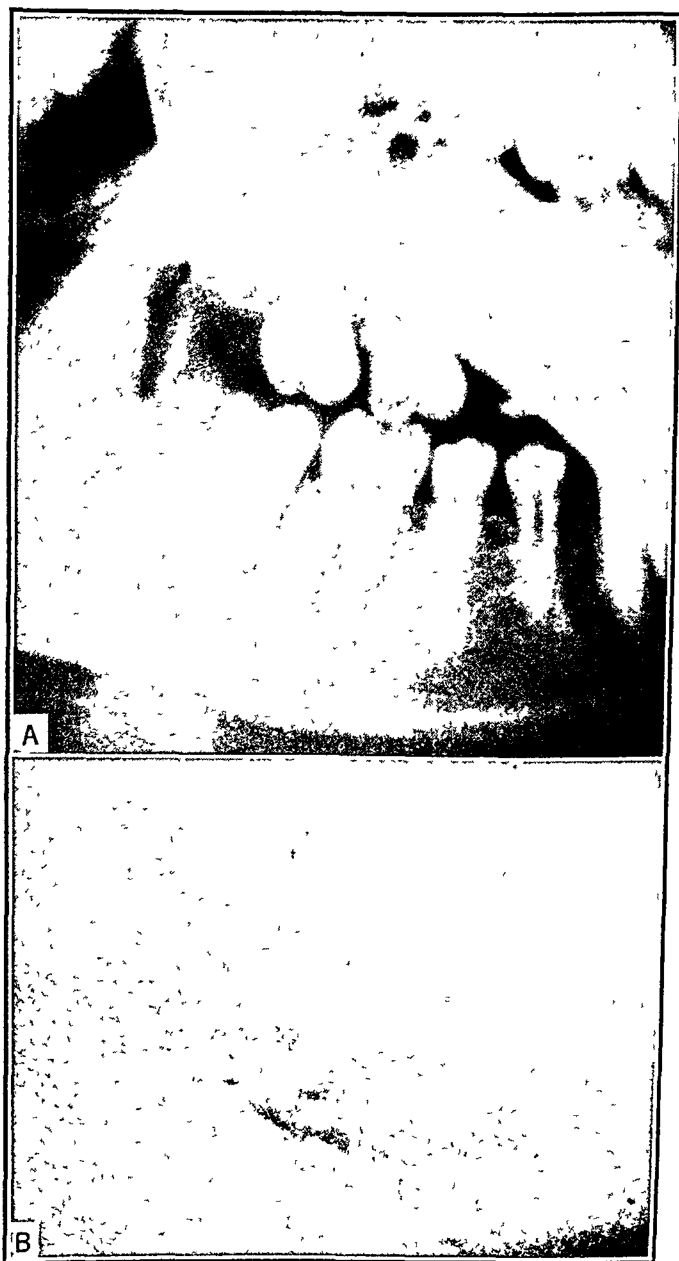


FIG 205 Case of a chronic draining sinus on the surface of the face incorrectly diagnosed as actinomycosis by the patient's physician *A*, Lateral jaw radiograph reveals the area of circumscribed infection around the root of the first molar At the time of extraction of this tooth a probe could be passed readily from the periapical area to the sinus opening on the skin surface. *B*, Scarred opening of the sinus tract (Tam, courtesy of Dent Items of Interest)

infection may retain its chronic status by emitting a steady stream of pus or watery fluid through a sinus tract to the surface of the oral mucosa or skin.

Treatment of chronic periapical disease may be either radical or conservative. The most curative method of management consists of extraction of the tooth and removal of the chronic abscess, granuloma, or small cyst by curettage. The technic for these measures has already been described (p. 87). Conservative management calls for sterilization and filling of the root canal and removal of the granuloma through the access provided by a small flap (apical curettage) or the same steps plus amputation of the exposed portion of the root (apicoectomy). Selection of the proper treatment plan is made after consideration of the value of the tooth, if retained, and possible medical contraindications to retention of a pulpless tooth.

Periodontoclasia. This is the commonest diffuse form of chronic infection found in the field of dentistry. Although painless, it may serve as the soil on which acute infection may become established, or it may result in bacteremia with the possibility of metastatic infection. The disease is eliminated, of course, by the extraction of the involved teeth. Conservative treatment measures lie within the field of periodontology.

Wounds, Burns, and Ulcerating Tumors. These may foster the growth of a mixed or pure culture of pathogenic bacteria. Pulaski has described well the situation which commonly develops in third degree burns which have been inadequately surgically or chemotherapeutically treated by stating, ". . . the burn becomes a quagmire of resistant and inhibitory organisms, with the staphylococci, Proteus, and Pseudomonas dominating the mixed and varied flora."[28]

Chronic Lymphadenitis. This may result from septic teeth, tonsils, or sinuses. The nodes are usually firm, movable, and nontender. The condition must be differentiated from Hodgkin's disease, lymphosarcoma, and carcinomatous metastasis.

Sialolithiasis. Sialolithiasis, particularly in the submaxillary salivary gland or duct, may be attended by infection due to partial or complete blockage of the lumen by the stone. Swelling of the submaxillary gland and of the duct itself along its course in the floor of the mouth occurs intermittently, usually at mealtimes. The method of removing a submaxillary stone is described on page 139. The presence of stone in the parotid gland or duct is rare.

Tuberculosis, Syphilis, and Actinomycosis. These diseases may invade the mouth and jaw area. All may now be effectively treated with properly chosen antibiotic agents. *Actinomycosis* is the only one of these generally considered to lie within the field of oral surgery. The diagnosis should be suspected in every case of prolonged, low grade, indurated inflammation of the cheek, jaw, or neck region which is attended by multiple abscesses or draining sinuses, even though the ray fungus cannot be demonstrated on examination of the exudate. *Treatment* consists of heavy doses of

penicillin, chlortetracycline, or oxytetracycline for a prolonged period, at least four to six weeks,[29] in conjunction with surgical opening, curettage, and packing of the nodules and sinuses.



FIG 206 Actinomycosis of the jaw and neck (Ormsby and Montgomery, *Diseases of the Skin*)

LOCAL ACUTE INFECTIONS

DENTO-ALVEOLAR INFECTIONS. 1. *Acute pulpitis* develops whenever pathogenic organisms enter the pulp in association with injury or reduced blood supply. Zander has shown that pulpal healing can occur in the dog in spite of severe thermal burns.[30] This favorable outcome seldom occurs in the human, however, due to the frequent association of infection through a carious lesion. The pain of pulpitis may be very severe, although intermittent, and may be referred to other teeth or to the ear, forehead, or neck Heat usually aggravates the symptoms, but the application of ice relieves them. The alternate use of heat and cold serves as a valuable diagnostic test to determine which tooth is diseased.

2. *Acute periapical abscess* may develop immediately after infection of the pulp, being then spoken of as *primary*, or it may form on a previously existing chronic periapical lesion, in which case it is known as a *secondary* acute periapical abscess. At this stage tenderness to percussion and elongation are usually present, along with throbbing pain in the immediate area. Fever, leukocytosis, and increased pulse rate are frequently found.

3. *Lateral* or *paradontal abscess* usually develops on a vital tooth which has a deep pocket resulting from periodontoclasia. The acute condition develops when pus can no longer drain from beneath the gingival cuff and a vicious cycle is set up, for the greater the edema, the tighter the cuff clings to the root surface.

4. *Acute dento-alveolar abscess* represents an extension of an acute periapical abscess. As pressure develops within the alveolar process it seeks an outlet by the path of least resistance. This leads labially

or buccally in most instances, but it may be toward the lingual, or the pus may burrow deeply to involve fascial compartments or anatomical spaces such as the antrum or nasal cavities. The seriousness of the infection is greater when pyogenic infections fail to point near to their source.



FIG 207. Acute dento-alveolar abscess of upper facial area. *A*, Before, and *B*, after treatment

This common infection serves as an excellent example for application of the principle that all infections are made up of three phases or factors. First, the pathogenicity or virulence of the invading *bacteria* determines the amount of invasiveness and morbidity that will be found. Second, the anatomical location, paths of least resistance, and physical properties of the *tissues in which the bacteria are growing* will all affect the course of the disease, and determine, to a large extent, the surgical treatment. Third, the level of the *patient's resistance* will play an important part in determining the severity, duration, and morbidity of the disease.

The *treatment* of acute dento-alveolar abscess should be pointed toward removal of the offending tooth at the earliest moment which is consistent with safety. Incision and drainage may be performed before or concurrently with the extraction, if pus does not flow from the socket when the tooth is removed. All possible measures should be used to bolster the patient's resistance. The use of antibiotics is optional, depending to a large extent upon the seriousness of the local and systemic effects of the infection.

Rovelstad studied the effects of four treatment regimens in children with acute alveolar abscess. Twenty-seven received sulfonamides, 22 penicillin, 28 aureomycin, and 16 served as controls. Aureomycin gave the most prompt reduction of morbidity as measured by peak temperature and days elapsed before acute symptoms subsided. Drainage occurred in 62 per cent of the control cases, 51 per cent of the sulfonamide treated, 31 per cent of those receiving penicillin, and none of the aureomycin group.[31]



FIG 208 Acute dento-alveolar abscess of lower facial area

5. *Pericoronitis* is most frequently seen around the crown of the erupting lower third molar tooth in young adults, but it may occur around any erupting crown. Although capable of causing considerable pain, especially from trauma to the swollen soft tissues during mastication, the infection usually tends to remain localized. *Treatment,* in addition to the general measures for all infections which have already been described, includes mechanical steps to reduce trauma to the edematous gum flap and to encourage drainage of the infected space behind and around the crown. The *upper* third molar may be ground or extracted to remove occlusal trauma.

Irrigation beneath the flap with sterile saline injected through a blunt needle is of benefit, or better still, the tense band of tissue which inhibits drainage may be tented up with a wisp of cotton impregnated with Ward's pack. This drain must be inserted with considerable force with a blunt stiff wire probe. In virtually all cases of pericoronitis the tooth will eventually have to be removed because of malposition.

6. Although the diagnosis and treatment of *Vincent's infection* are usually considered as lying in the field of periodontology, this disease has oral surgical implications in that it may be the forerunner of serious postoperative infections. The symptomatology has been reviewed in Chapter 3 (p. 65). No surgery which would expose bone should ever be performed during an acute attack of fuso-spirochetal infection.

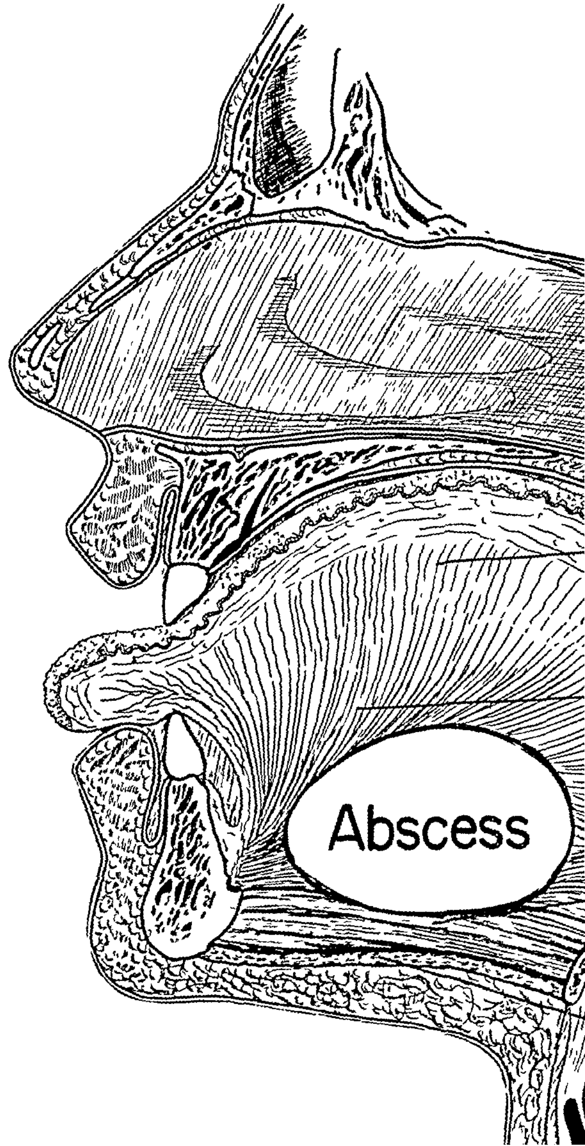
Soft Tissue Infections. 1. *Cellulitis.* This condition means different things to different writers. Ordinarily it is contrasted with *abscess* formation, wherein a pocket of pus is known to be present. Since, in deep infections, this distinction cannot always be made clinically, confusion has arisen regarding the proper terminology. The U. S. Army Medical Index of Diagnoses recognizes two types, "cellulitis, acute, nonsuppurative" and "cellulitis, acute, suppurative" and avoids use of the word "abscess." Much of the cellulitis seen in oral surgical practice is in the neck region, hence the expression "cervical cellulitis" is frequently encountered in the literature. The term is simply morphological and does not constitute a complete diagnosis.

2. *Lymphadenitis and Sialolithiasis.* Acute soft tissue infections in the neck region may develop by direct extension from a primary lesion in the mouth or jaw region or by suppuration of a previously chronically infected lymph node. A form of acute infection which is of particular interest in oral surgery is that which is associated with sialolithiasis in the submaxillary duct. (See pp. 21 and 333.) The rapid conversion of a large amount of retained saliva into pus under pressure is analogous to the acute infection of a large dental or follicular cyst. Incision and drainage, to relieve the acute symptoms due to fluid under pressure, is the first step in treatment of either condition. Drainage of a distended salivary duct should always be done intra-orally.

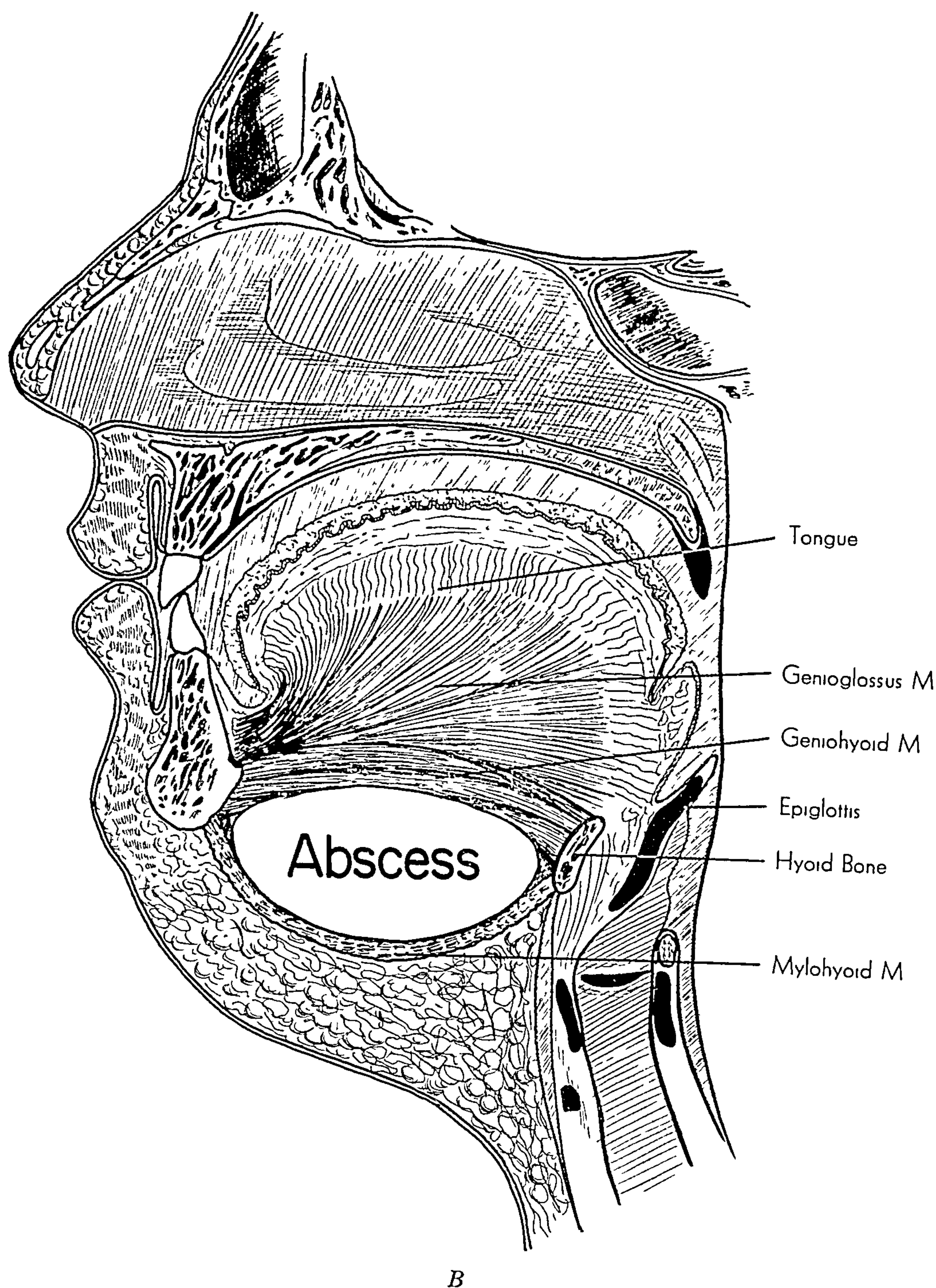
3. *Infections of Fascial Spaces.* The ways in which the course of infections may be altered by the physical properties of the anatomical structures involved have already been discussed. Many descriptions of spaces in the face, neck, and jaw areas have been reported in recent years. All of these descriptions are predicated on the ability of tough, fibrous sheets of connective tissue to resist the spread of purulent infections. Some of the envelopes formed by fascial layers are completely sealed, but most have one or more points of weakness which permit pus to exude from one space to another. The gravity of the disease produced by one of these fascial space infections is proportional to the amount of injury to

structures within the compartment, a
adjacent anatomical structures.

One of the common and serious forn
as *Ludwig's angina.* The word angina
off associated with pain. Although f
entity it is more properly regarded as a
by any infection in the *sublingual* or
significantly absent when infection is



M3
OR'5



B

FIG 209 *A*, Sublingual space infection Since the infection is above the geniohyoid and mylohyoid muscles the tongue is pushed upward and backward, and will protrude between the teeth. There is severe interference with respiration and swallowing *B*, Submental space infection If the infection is confined to the area beneath the geniohyoid muscle, as shown in the diagram, there will be marked swelling beneath the chin, but relatively little interference with respiration and swallowing.

infection is confined in the space between the base of the tongue and the geniohyoid muscle the predominant effect will be a pushing upward and backward of the tongue. When it is in the space between the geniohyoid and mylohyoid muscles the tongue will not be displaced to such a marked degree, but there will be a broad hard swelling beneath the chin. Either type interferes seriously with deglutition and respiration, and edema of the larynx, leading to asphyxia, may develop rapidly. The toxic effect of anaerobic organisms is heightened by the rapidly deteriorating resistance of the patient, brought about by inadequate supplies of fluids, nourishment, and oxygen.

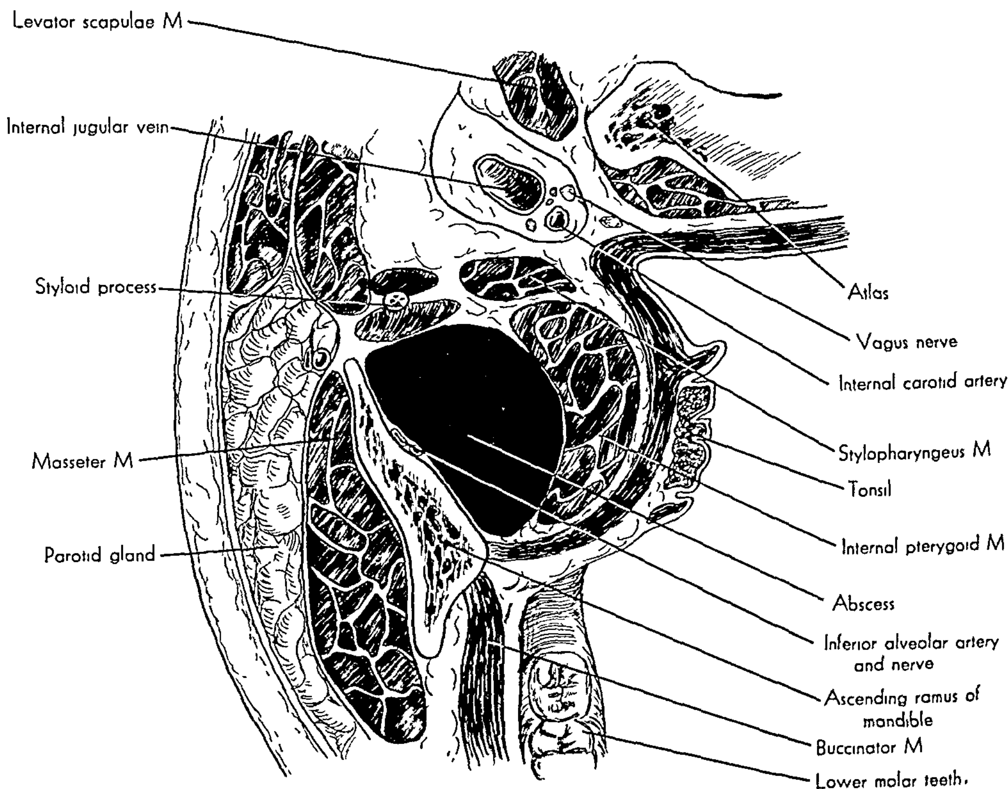


FIG 210 Lateral pharyngeal (parapharyngeal) space infection (Transverse section at the level at which the mandibular block injection is made) (After Callender)

For convenience of understanding, three spaces may be considered together as they *all produce trismus*. The *parapharyngeal space* (lateral pharyngeal) is situated on the inner surface of the ramus of the mandible. Infections here produce spasm of the *internal pterygoid* muscle. Infections of this compartment were mentioned earlier in connection with the "needle abscess" resulting from septic mandibular block injections. This is one of the spaces which communicates with the carotid sheath, which in turn permits unrestricted passage of purulent material to the mediastinum. Infections of the lower third molar area frequently spread to the *submas-*

seteric space, thus producing spasm of the *masseter*. The *infratemporal space* contains the external pterygoid muscle and pterygoid plexus of veins, and infections therein will produce pain on attempted opening due to irritation of the *temporal muscle*.

Infections within the *parotid space* are of interest because they may arise from an ascending infection by way of the parotid duct associated with dehydration and lowered resistance developing from any serious febrile disease. Acute septic parotitis was once considered nearly a fatal complication of typhoid fever or pneumonia. Poor oral hygiene was usually felt to be a causative factor and the development of this condition was a reflection on the nursing care. Since the fascia covering the parotid gland is very tough, external surgical drainage through this capsule constituted the essence of treatment, prior to the antibiotic era.

Of the many other spaces which have been described in the literature, only the *buccal* and *submaxillary* will be mentioned. These are relatively superficial, compared to the others which have been mentioned, so that infections therein are less likely to be overlooked; drainage may be accomplished readily through an external incision.

4. *Noma*, which is fortunately an extremely rare infection, is mentioned only because it typifies the ultimate of low bodily resistance.

5. *Antibiotic Therapy for Soft Tissue Infections*. Mallett stated that the annual number of skin incisions for drainage of alveolar abscess dropped from 40 to 11 in Boston City Hospital with the advent of antibiotics.[24] Osserman reported that in 30 cases of cellulitis which would normally have required surgical drainage, resolution was achieved with 27 by the use of oral terramycin.[32] Grimm *et al.* treated 35 cases of infections of teeth and jaws with 1 gram of aureomycin daily and another group of 22 cases with 2 grams daily. Fifty-five per cent of the first group and 91 per cent of the second made an excellent recovery.[33]

In 1945, when the supply of penicillin was limited and the cost high, individual and total dosage used to treat cellulitis of the jaws was much smaller than at the present time. In that year Dorner and Morgan,[34] Allen,[35] Stern,[36] and Ferro[37] reported cures of such cases with total doses as low as 100,000 to 480,000 units. With penicillin now in plentiful supply there would seem to be no reason for inviting the development of resistant strains of bacteria by small dosages.

A number of reports have been published wherein cellulitis failed to respond to penicillin, but prompt recovery followed after substitution of another antibiotic. Toole used intravenous aureomycin in 2 cases of Ludwig's angina in which swallowing was difficult. Both had been receiving penicillin without benefit. The intravenous aureomycin was supplemented with oral capsules as soon as possible.[38] Levy found terramycin curative in a case of sublingual phlegmon which had failed to respond to penicillin.[39] Lane *et al.* used terramycin in 4 cases of the same disorder, a part of the sub-

stance being given intravenously in 3 of the patients. One of their cases developed a unique terramycin-penicillin antagonism manifested by clinical improvement during periods when either agent was given alone but relapse when both were given together.[40]

One case of noma has been reported which was treated by aureomycin both locally and systemically. The patient died of coronary occlusion and decompensation but at the time of death the cheek lesion was healing.[41]

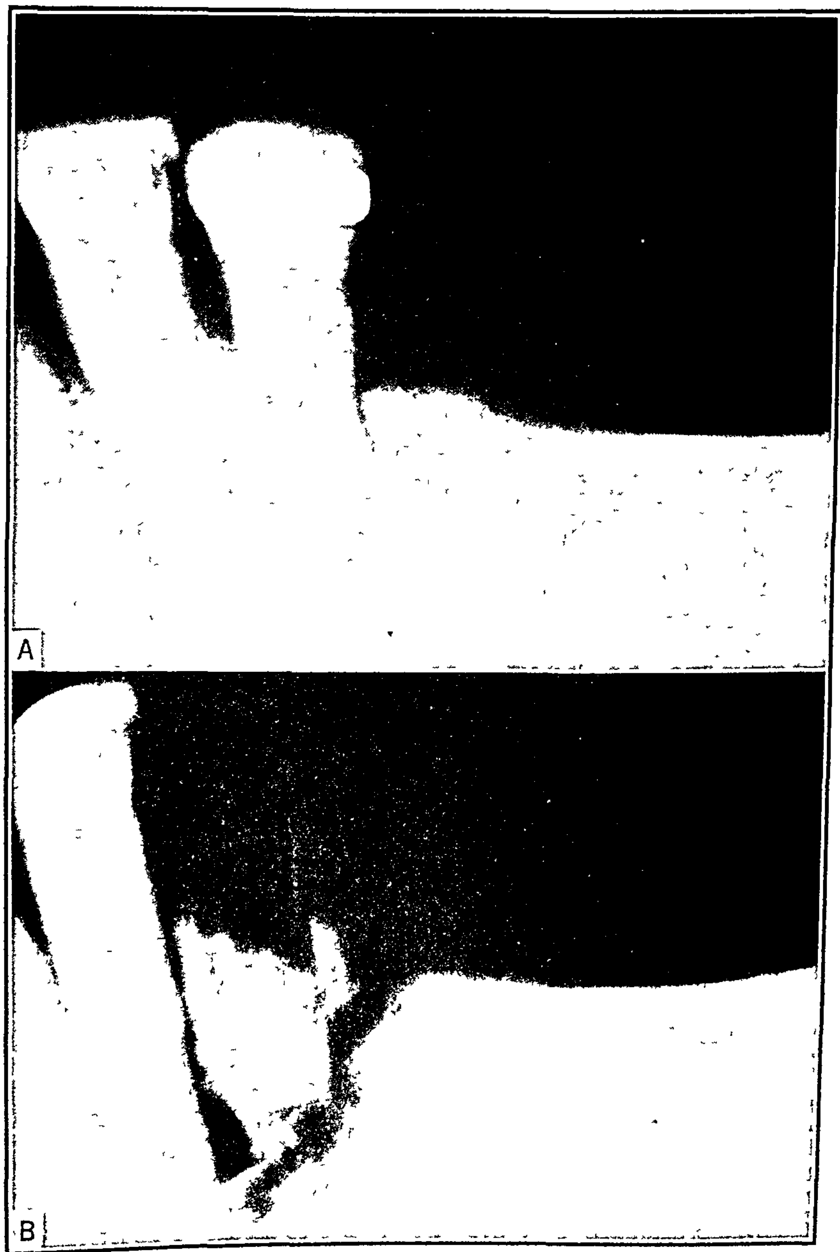


FIG. 211. Localized osteitis with sequestrum formation following extraction *A*, Preoperative radiograph, *B*, six weeks after extraction The socket of the first bicuspid had failed to heal and was filled with exuberant granulation tissue and pus

Bone Infections. 1. *Localized Osteitis.* This is a clinical term used to describe any inflammation of bone which tends to be self-limiting. Dry socket, denuded bone, and acute dento-alveolar abscess are all really types of localized osteitis, with the common features of steady severe pain and protracted course, frequently leading to death of bone. There is no sharp line of differentiation between osteitis and osteomyelitis and the separation of one from the other is even more difficult when inadequate antibiotic therapy has been administered. For that matter, it is difficult to discriminate infections in bone from those in soft tissues in their early



Fig. 212 Osteomyelitis of the mandible The involucrum or shell of new periosteal bone may be seen at the lower border. (Courtesy, Dr L G. Rigler)

stages. It is because *the early treatment of all acute infections is essentially the same* that detailed, individualized treatment regimens are not outlined in this text.

2. *Osteomyelitis.* Before antibiotic drugs were freely available, full blown osteomyelitis of the mandible was seen quite frequently. Classical cases are now seldom encountered. Due to the widespread early use of antibiotics the disease is either aborted or is reduced to a moderate case of localized osteitis. With the continued use of these drugs for all severe mouth and jaw infections it is quite probable that the old-fashioned type of osteomyelitis of the mandible with its pathetic deformities may virtually become extinct.

(*a*) *Etiology.* While any pathogenic micro-organism may cause the disease, staphylococcus aureus is the offender in the vast majority of cases. Any odontogenic infection may precede the massive

bone infection, but poorly-timed or executed surgical procedures are usually a contributory etiological factor. Compound fracture of the mandible may be followed by osteomyelitis, although there is some question whether the localized type that is usually associated with fractures should be given the term which is usually reserved for the purely infectious variety which extends through the entire body of the mandible. The segmental nature and necrosis in block form of osteomyelitis suggest strongly that thrombosis of blood vessels either by trauma or bacteria plays a major part in the development of this disease. Thrombosis of the inferior alveolar artery and vein would sharply reduce the blood supply to the mandible and encourage the establishment of bone infection distal to the point of occlusion. Since the vascular supply to the mandible is not provided with as many anastomoses as that of the maxilla, the rarity of osteomyelitis of the upper jaw might thereby be explained.

(*b*) *Symptoms and Signs.* Any of the following findings are nearly pathognomonic of osteomyelitis and the presence of several is usually sufficient to make the clinical diagnosis.

1. Severe, intractable pain.
2. Intermittent high fever, malaise, and bodily illness.
3. Formation of large quantities of pus, either as a steady flow from one or more apertures, or as a massive swelling, if there is no escape for the purulent fluid.
4. Loosening of multiple teeth.
5. Moth-eaten appearance on radiographic examination after fourteen to twenty-one days.
6. Ultimately, separation of sequestra.

(*c*) *Treatment.* In addition to the general measures used for all infections of the mouth and jaws, there are two specific features of local treatment that must be mentioned. First, extraction of teeth, no matter how loose, should be avoided or at least deferred as long as possible, for they often tighten up after recovery and regain their ability to respond to vitality tests. Retention of teeth maintains the shape and form of the jaw during the period when its structure is seriously weakened by necrosis. Regeneration of an entire mandible from the involucrum is the rule, if a conservative course is followed regarding extractions. Second, the removal of dead bone, a treatment feature which is unique with this disease, should be done according to plan. Small spicules may be picked out through a draining sinus, but large sequestra should be removed through an adequate surgical incision. Occasionally the infection is diffuse and there is no separation *en masse* of a block of necrotic bone In such a case saucerization may be done, which consists of curettage of all surfaces of involved bone through a wide surgical opening. If the resulting surface is clean and bleeding at all points, primary closure may be performed under the continued protection of heavy antibiotic therapy.

Case reports of osteomyelitis treated with antibiotics indicate that mixed therapy is frequently used, which introduces difficulties in

accurate appraisal. Since a well-established osteomyelitis is likely to run a course of several months, opportunity exists for development of resistant strains of bacteria under antibiotic therapy. Thoma encountered a case of osteomyelitis of the mandible from which B. coli was isolated, with inhibition by streptomycin in dilutions of .004 milligrams per cubic centimeter. The patient was treated with both streptomycin and penicillin for one week at which time cultures were sterile. Penicillin alone was continued for another week, then sequestrectomy and saucerization were done, followed by penicillin instillation through Dakin's tubes.[42] In Hagstrom's case a total of 52 injections of penicillin were used extending over a period of five months.[43] Egan, in 1950, reported what he believed to be the first instance wherein osteomyelitis of the mandible was treated with aureomycin. Penicillin failed to stop the drainage which aureomycin effectively controlled.[44]

3. *Osteoradionecrosis.* This type of necrosis is discussed under complications of cancer, p. 233.

SUPPURATIVE INFECTION OF THE TEMPOROMANDIBULAR JOINT

Purulent arthritis of this joint may occur in infancy or childhood by direct extension from a middle ear or mastoid infection. In the adult the same process may result from compound fractures or hematogenous infection, one type of which is that due to the gonococcus.

Treatment, in addition to antibiotic therapy, consists of incision and drainage, rest for the acute period, and gradual resumption of motion as the infection subsides. Partial or complete ankylosis is a frequent sequella.

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~ 13 ~

Miscellaneous Oral Surgical Operations

TRANSPLANTATION OF DEVELOPING TEETH

Loss of the first permanent molar is often followed by drifting of adjacent teeth and extrusion of opposing teeth into the space which remains after extraction. For many years ways have been sought to easily and effectively maintain the space and prevent extrusion of teeth in the opposing jaw. In 1950 Apfel described a method of transplanting incompletely formed third molars into the space previously occupied by the first molar.[1] Miller,[2] Hale,[3] Clark and Tam,[4] Noble,[5] and others have used modifications of Apfel's method with success.



FIG 213 FIG 214

FIG. 213 Radiographic appearance of incompletely formed lower third molar before transplantation

FIG 214 Appearance immediately after transplantation.

The technic used at this institution has evolved from a completely aseptic procedure in the hospital operating room to a much simpler and briefer routine in the oral surgery clinic. Two features of the original method gave the greatest difficulty, removal of the delicate membrane around the crown without tearing and creation of an excavation deep enough to bury completely the transplant. Following the suggestion of Hale in February 1953 no effort has been made to save the sac, and the transplant has been established at a much higher level than formerly. These two important changes have greatly simplified the operation and the over-all results are better.

In a series of 19 lower third molar transplants performed in this clinic all retained good color, firm attachment, and healthy periodontium for the period of observation. Positive responses to electrical and thermal pulp tests were achieved in 43 per cent by the fifth month and in 85 per cent by the eighth month. The adverse features were marked diminution in size of the pulp chamber, failure of the roots to grow, and a tendency to ankylosis at the site of implantation. These features are demonstrated in the photo-

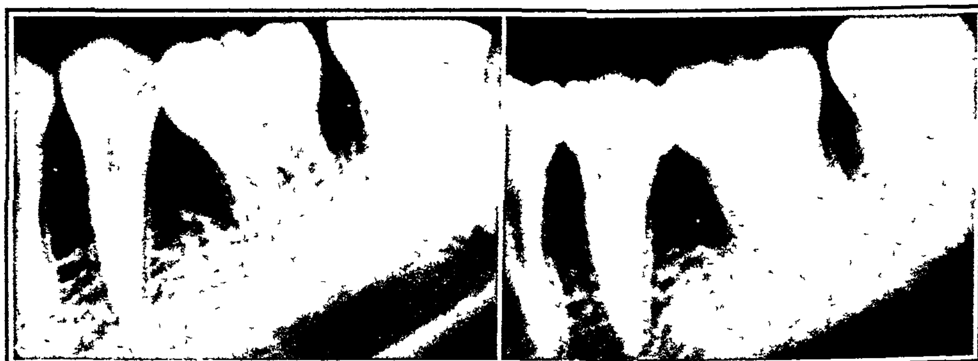


FIG. 215 FIG. 216

FIG 215 Two months after transplantation
FIG. 216 Six months after transplantation.



FIG 217 Decalcified section of transplanted tooth which was extracted because of malposition. Note small pulp chamber but vital pulp (× 7 magnification.)

micrographs (Figs. 217 and 218) derived from decalcified sections of two transplanted teeth which were removed after twelve months because of malposition and ankylosis.[4]

At the present time transplantation is a practicable means of replacing missing first molars in cases where the third molar is available and has roots at the proper stage of development. The experience of all workers has indicated that the bifurcation should be established but the apical foramina should be quite wide open. Establishment of the new tooth about 1 millimeter below the occlusal plane insures satisfactory position even though no eruption occurs



FIG 218 Higher magnification of apex in case where extraction was performed because of malposition Note vital pulp tissue, irregular cementum, and periodontal membrane fibers (× 30 magnification.)

because of ankylosis. The transplant should be protected and stabilized for approximately fourteen days with a splint made of wire and surgical pack material.

Three transplants of upper third molars to first molar positions have been done in this clinic with success equal to that secured with lowers.

Implant Dentures

Most edentulous patients can achieve a good degree of function, comfort, and improvement in appearance from dentures made in the conventional manner. Some can reach this degree of success only after preliminary surgical treatment such as excision of hypertrophied tissue or deepening of labial sulci. A small minority of

patients have great difficulty wearing their prostheses, particularly the lower, because of marked resorption of alveolar ridges. For these people the implant denture may be considered as a means of securing retention and stability far beyond that provided by unattached replacements.

In the implant denture, fixation is achieved by seating the tooth-bearing element or "superstructure" on four absolutely parallel posts which emerge through the oral mucosa from their origin in

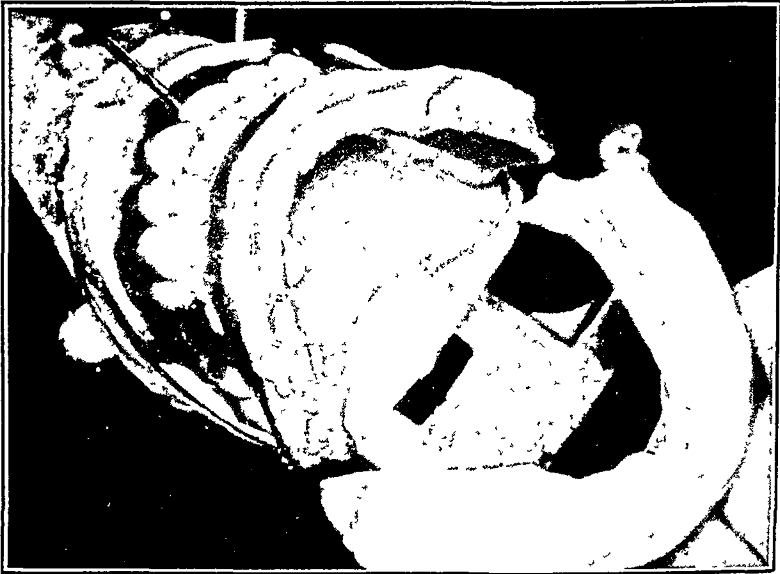


FIG 219 Articulator and impressions.
(Westerberg and Clark, courtesy of Jour Oral Surg)

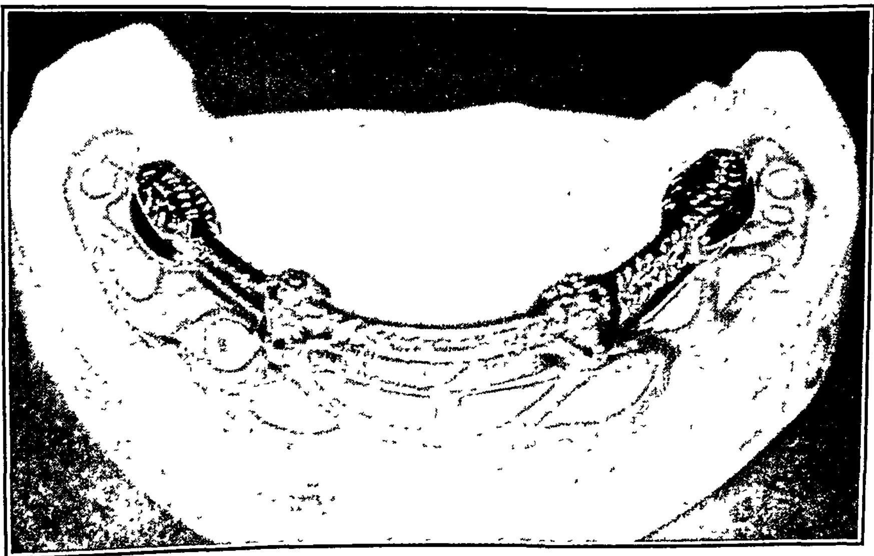


FIG 220 Stone model and implant frame.
(Westerberg and Clark, courtesy of Jour Oral Surg)

the embedded framework. Very briefly, the technic of construction and insertion of a lower implant denture, to be used in conjunction with a conventional full upper denture, is as follows:

1. Impressions are taken of upper and lower arches and full dentures made in the usual manner up to the point of the waxed up trial dentures, bearing acrylic teeth.

2. With the use of a specially made acrylic tray and low fusing wax an impression is taken of the bare bone of the lower ridge after large flaps have been reflected from buccal, labial, and lingual aspects of the mandible. Before the impression is taken the bone

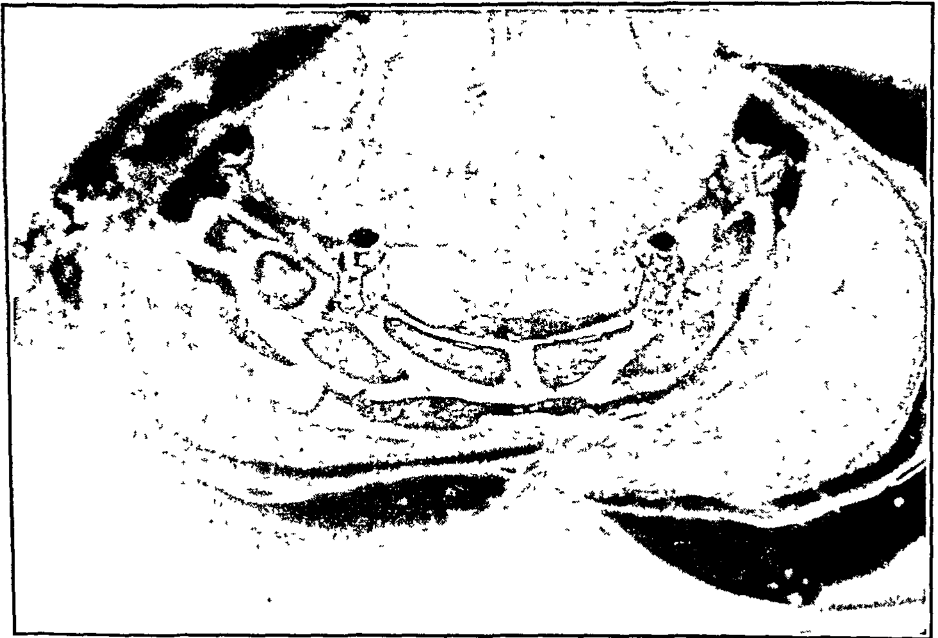


FIG. 221. Implant base seated on exposed bone. (Westerberg and Clark, courtesy of Jour. Oral Surg.)

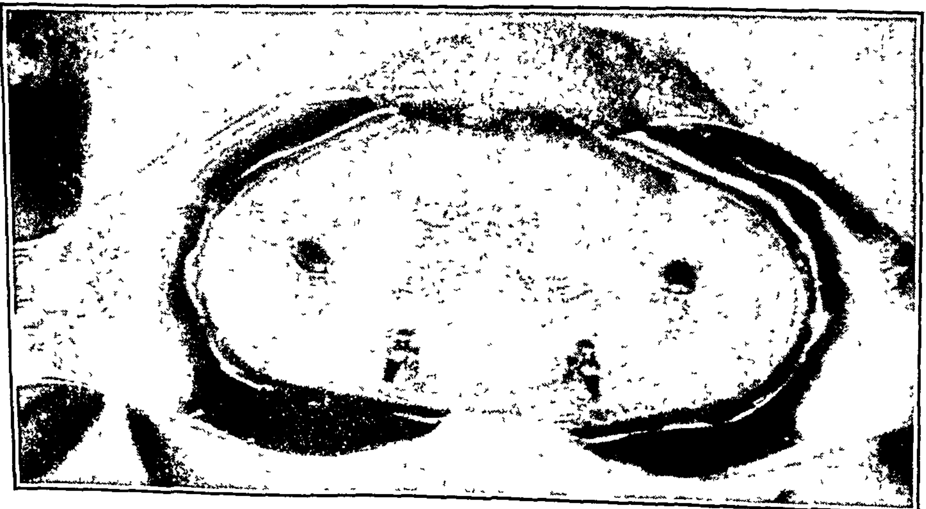


FIG 222. Healed implant base, posts protruding through mucosa. (Westerberg and Clark, courtesy of Jour. Oral Surg.)

is scored with transverse bur cuts in several places, and these grooves serve as localization points in later steps.

3. A model is poured from the bone impression and sent to a Vitallium laboratory, along with the waxed up dentures. The metallic implant, including its precision ground posts and the metallic framework of the superstructure, are fabricated in the commercial laboratory.

4. A second operation is performed for permanent insertion of the implant, which consists of again raising the flaps which were outlined in the first operation, and laying the metal framework in place. No pins or screws are used. The mucosa is carefully replaced over the framework and held with interrupted sutures. The posts, of course, project into the mouth.

5. Meanwhile, the lower denture has been completed, having been built around the metallic framework of the superstructure. When healing is complete, the prosthesis is inserted in much the same way as a precision built partial denture.

Construction and insertion of one of these cases is infinitely more complex than that for ordinary prostheses. Failure to secure a well-balanced occlusion may lead to loosening and partial extrusion of the implant. Histological examination of tissues around the posts in humans and laboratory animals reveals a certain amount of chronic inflammation and a tendency for oral epithelium to grow down along the surface of the metal to an indeterminate distance.[6,7] On the other hand, during the short period of observation of a small number of cases, stability, retention, and comfort have been achieved for all patients.

The procedure is decidedly experimental at the present time, and should be reserved for patients who thoroughly understand the possibilities for failure, and who cannot be cared for by dentures made in the usual way.[8]

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14

Drugs and Pharmaceutical Preparations

THE drugs included in this list constitute most of the preparations that are needed to treat oral surgical disease. For complete pharmacological descriptions the reader should consult one of the standard texts on pharmacology, The United States Pharmacopeia, Accepted Dental Remedies, New and Nonofficial Remedies, or the Physician's Desk Reference. Many preparations are also put up in other forms and sizes than those given. Registered trade names are indicated by the symbol®.

The doses given are for adults. Children's doses may be calculated from the following table, derived from Young's rule:

Age	*Dose*
2 years	1/[illegible] the adult dose
3 years	$\frac{1}{5}$ " " "
4 years	$\frac{1}{4}$ " " "
6 years	$\frac{1}{3}$ " " "
9 years	$\frac{2}{5}$ " " "
12 years	$\frac{1}{2}$ " " "

ANALGESICS

Acetylsalicylic acid, U.S.P., is used in the oral tablet form. The dose is 0.3 to 0.6 gram (5 to 10 grains).

Anacin® (Whitehall) contains acetophenetidin, acetylsalicylic acid, and caffeine. The dose is 1 or 2 tablets.

Empirin compound® (Burroughs, Wellcome) also contains acetophenetidin, acetylsalicylic acid, and caffeine and the dose is also 1 or 2 tablets.

Empirin compound with codeine® (Burroughs, Wellcome). In addition to the ingredients mentioned above, tablets number 1, 2, 3, and 4 contain codeine phosphate $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, and 1 grain, respectively. The dose of numbers 1, 2, and 3 is 1 or 2 tablets, and of number 4 is 1 tablet.

ASA and codeine compound® (Lilly). In addition to acetophenetidin, acetylsalicylic acid, and caffeine, tablets number 1, 2, 3, and 4 contain codeine phosphate $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, and 1 grain, respectively. The dose is 1 or 2 tablets for numbers 1, 2, and 3, and 1 tablet for number 4.

Morphine sulfate, U.S.P. may be given orally, intramuscularly, or intravenously. The dose is .010 to.016 gram ($\frac{1}{6}$ to $\frac{1}{4}$ grain).

Pantopon® (Hoffman-La Roche) is given by injection. Due to the inclusion of all the alkaloids of opium there tend to be fewer side effects. The dose is .020 gram ($\frac{1}{3}$ grain).

Demerol® (Meperdine hydrochloride, Winthrop-Stearns) may be given orally or by injection. The dose is .050 to .100 gram.

Dilaudid® (Dihydromorphinone hydrochloride, Bilhuber-Knoll) may be given orally or by injection. The dose is .002 to .003 gram ($\frac{1}{32}$ to $\frac{1}{20}$ grain).

Dolophine® (Methadon hydrochloride, Lilly) may be given orally or by injection. The dose is .0025 to .010 gram.

ANTIBIOTICS

Although numerous preparations are available containing both penicillin and sulfonamides, and penicillin and streptomycin, only those containing a single chemotherapeutic agent are listed. Mixtures of crystalline with procaine penicillin are also available.

PENICILLIN

A. *Oral Preparations.* 1. *Tablets* containing crystalline penicillin or procaine penicillin in amounts varying from 50,000 to 250,000 units per tablet are available from a large number of manufacturers. Most contain buffering agents. Among those on the market are: Penicillin potassium tablets (Abbott), Ledercillin® (Lederle), Duracillin® (Lilly), Pentids® (Squibb), Penicillin potassium tablets (Upjohn), and Penioral® tablets (Wyeth).

Bicillin® (Dibenzylethylenediamine dipenicillin G, known as DBED, Wyeth) tablets contain 100,000 units each of this very sparingly soluble penicillin preparation.

Penicillin O is available as Cer-O-Cillin® (Upjohn) in the form of buffered oral tablets containing 100,000 units each.

2. *Liquid Preparations.* Most oral liquid preparations of penicillin are put into solution at the time the prescription is filled by the pharmacist, with instructions to keep under refrigeration, and to be used within ten to fourteen days. Liquid preparations, with various sweetening and flavoring agents, and with varying amounts of penicillin per teaspoonful, are sold by the following drug houses: Permapen® (Oral suspension of DBED, Pfizer), Eskacillin® (Liquid oral procaine penicillin suspension, Smith, Kline, & French), Neolin® DBED (Lilly), Sugracillin® (Upjohn), Dramcillin 500® (White), and Bicillin® (Oral liquid preparation of DBED, Wyeth).

B. *Injectable Preparations.* 1. *Crystalline penicillin G,* in the form of either the sodium or potassium salt, is marketed as the dry powder, to be put into solution immediately before use. Single and multiple dose vials are available from Abbott, Lederle, Merck, and Upjohn.

Injectable penicillin O is available in vials containing 200,000 units of Cer-O-Cillin® (Upjohn).

2. *Procaine Penicillin Precipitate.* Virtually all products of this type are standardized at 300,000 units per cubic centimeter. Some

are sold as the dry powder, and others are ready mixed in aqueous suspension. Suspensions in oil are seldom used now. Many preparations of this type are now put out in single dose disposable cartridges or "cartrids." The following pharmaceutical houses offer procaine penicillin preparations: Abbott, Lederle (Ledercillin®), Lilly (Duracillin®), Merck, Pfizer, Squibb (Crysticillin®), Upjohn (Diurnal® penicillin), and Wyeth (Wycillin®).

3. *Bicillin® L-A Injection* (Dibenzylethylenediamine dipenicillin G, known as DBED, Wyeth) is available as single dose "Tubex" carpules in 300,000 and 600,000 unit doses. A single intramuscular injection of 300,000 units of this preparation results in perceptible blood levels for fourteen days. A single dose of 600,000 units extends the effect for even longer periods.

Tetracycline Preparations

A. *Chlortetracycline* (Aureomycin®, Lederle) is available in oral capsule, oral liquid, and injectable form for intravenous use. The usual oral dose is .250 gram every four to six hours. Gastro-intestinal side effects occur, being more frequent with larger doses.

B. *Oxytetracycline* (Terramycin®, Pfizer) is dispensed in oral capsule, oral liquid, and injectable form for intravenous use. The dosage and side effects are similar to those of chlortetracycline.

C. *Tetracycline* (Achromycin®, Lederle; Tetracyn®, Roerig; Panmycin®, Upjohn; and Polycycline®, Bristol) may be obtained in the same forms as the two previously mentioned antibiotics. The dose is the same, but side effects such as diarrhea are said to be less frequent.

Erythromycin

Erythromycin (Ilotycin®, Lilly and Erythrocin®, Abbott) is available in .100 gram tablets and in forms for intravenous injection. The dose is 400 to .600 gram every six hours. The spectrum of this preparation is essentially the same as that of penicillin, but it is said to be effective often against organisms which are resistant to penicillin. Gastro-intestinal side effects are milder and less frequent than with the members of the tetracycline group.

Streptomycin and Dihydrostreptomycin

The pharmaceutical manufacturers: Lilly, Merck, Parke, Davis, Upjohn, and Wyeth offer both forms of this substance. When it is used for oral surgical infections the dosage should be relatively low and for brief periods to minimize the possibility of eighth nerve injury. One-half gram intramuscularly every six to twelve hours, for a total of four to six days is suggested.

Bacitracin

Although this potent antibiotic is known to be active against many gram-positive and some gram-negative bacteria it can be used only in topical form because of the frequency with which it causes kidney damage when injected. It has the advantage of seldom pro-

ducing resistant strains of organisms. Ointments containing 500 units per gram are available from Abbott, Lilly, Pfizer, and Upjohn.

ANTIHISTAMINES

Benadryl® (Diphenhydramine hydrochloride, Parke, Davis) may be used in oral tablet or elixir form. The dose is .025 to .050 gram. Each teaspoonful of the elixir contains .010 gram. Drowsiness is quite common with this as with others of the antihistaminic group.

Pyribenzamine® (Tripelennamine, Ciba) is usually given in the form of oral tablets, and the usual dose is .050 gram.

Chlor-trimeton maleate® (Schering) is offered in oral tablet, syrup, and injectable form. The dose is .004 to .020 gram

Phenergan hydrochloride® (Wyeth) is available in oral tablet form The dose is .0125 to .025 gram.

Pyronil® (Lilly) may be given in oral tablet form in a dose of .015 gram. Co-pyronil® pulvules (capsules) contain pyronil, histadyl, and copane. The dose is one capsule.

Neohetramine® (Thonzylamine hydrochloride, Nepera) is available in oral tablet and syrup forms. The dose is .050 to .100 gram. The syrup contains .025 gram per teaspoonful.

ANTISIALOGOGUES

Atropine sulfate, U.S.P. is usually injected, but may be given orally. Atropine paralyzes the parasympathetic nerve endings, including those of the vagus. The dose is .0005 gram ($\frac{1}{120}$ grain).

Scopolamine hydrobromide, U S.P , sometimes called hyoscine hydrobromide, is also usually given by injection. The action is similar to that of atropine, but hallucinations occur occasionally and amnesia is fairly frequent. The dose is .0005 gram ($\frac{1}{120}$ grain).

CAUTERIZING AGENTS

Phenol, U.S.P. A concentrated solution of the crystals may be used to cauterize the interior of bony cavities from which tumors have been removed that have a tendency to recur. Extreme care must be exercised not to unintentionally burn adjacent structures. The phenol should be promptly neutralized with cotton balls soaked in 70 per cent alcohol

Silver Nitrate, U.S.P. The "lunar caustic" stick, slightly moistened with water, may be touched to the area to be cauterized, or a 25 to 50 per cent solution in distilled water may be used. The action is arrested by the application of sodium chloride. The same precautions against burning apply as in the case of phenol.

DRESSINGS AND OINTMENTS

Iodoform (N.F.) *gauze.* This material is sold by several manufacturers as 5-yard strips of selvedge gauze $\frac{1}{4}$, $\frac{1}{2}$, and 1 inch wide,

impregnated with iodoform. The ½ inch size is most satisfactory, if only a single width is to be kept on hand. When incorporated with acrithesin ointment (see below) it is used to dress bony cavities. Plain gauze is also available, but tends to become foul very quickly in wounds, even when impregnated with ointments.

Acrithesin ointment, formerly a proprietary preparation, is no longer on the market in prepared form. It may be made up from the following formula:

Anesthesin (benzocaine)	4 0%
Chlorbutanol (chloroform derivative)	8 0%
Acriflavine, neutral	0 1%
Eugenol	2 0%
Petrolatum, q. s	

Iodoform gauze may be readily coated with the ointment by placing the bottle of gauze in a half inch of hot water and adding 1 or 2 teaspoonfuls of ointment, then stirring intermittently with a sterile rod. Short lengths are removed with a sterile forceps and cut off with a sterile scissors as needed.

Ward's Pack®. This proprietary preparation is commonly used to relieve the severe pain of "dry socket." The powder is stated to contain zinc oxide, powdered pine rosin, talc, and asbestos. The liquid contains isopropyl alcohol 10 per cent, clove oil, peanut oil, camphor, and coloring material. The dressing is made by placing a small amount of powder, liquid, sterile petrolatum, and sterile cotton on a square of wax paper, and mixing with a spatula. After the socket has been gently irrigated, dried, and isolated with cotton rolls the dressing is gently put to place. The petrolatum prevents hard setting and the cotton permits later removal in one piece.

A similar dressing may be made from the formula found in Accepted Dental Remedies:

Powder	Zinc oxide	1 part
	Rosin	1 part
Liquid	Eugenol	1 part
	Mineral oil	3 parts

GERMICIDES

Mild tincture of iodine, U.S.P., is an alcoholic solution of iodine 2 per cent, and sodium iodide 2.3 per cent, in 46 per cent alcohol. This is an effective preparation for sterilizing oral mucosa prior to local anesthetic injections, but does produce annoying stains of clothing and linen.

Metaphen® (Abbott). The tincture is composed of 0.5 gram per 100 cubic centimeters of an alkalinized solvent consisting of alcohol 50 per cent, acetone 10 per cent, water, and dye. Stains may be removed with soap and water.

Merthiolate® (Lilly). The tincture and aqueous forms are both available in concentrations of 1 1000. Stains may be readily washed out.

Zephiran Chloride® (Benzalkonium chloride, refined. A mixture of high molecular, alkyl dimethylbenzyl ammonium chlorides, Winthrop-Stearns). Both tincture and aqueous forms are available in 1 1000 concentration. Zephiran is used in full 1·1000 strength for sterilization and storage of instruments. Rusting will occur unless sodium carbonate or "anti-rust" tablets are added. The solution should be changed weekly. If soap is used in cleaning instruments it must be thoroughly removed before placement in Zephiran, as the actions are antagonistic. Whenever possible, instruments should be sterilized by boiling or autoclaving. (See comments in Chapter 5 on cold sterilization, p. 121.)

Alcohol, U.S.P. may be used in the 70 per cent strength for sterilization of instruments or skin.

pHisohex® (Winthrop-Stearns) contains entsufon (sodium octylphenoxyethoxyethyl ether sulfonate), lanolin cholesterols, petrolatum, and hexachlorophene 3 per cent. When used for surgical scrubbing or skin preparation the usual time may be reduced due to the active germicidal action of hexachlorophene. A thin film of the latter remains on the skin, giving prolonged antisepsis.

HEMOSTATICS

Oxidized cellulose is available as Oxycel® (Parke, Davis) and Hemopak® (Johnson and Johnson). This absorbable material is put out in the form of "gauze" squares and also as the unwoven fiber. Thrombin and epinephrine are inactivated by the low pH of the material. The hemostatic effect is due, at least in part, to the acidic quality.

Gelfoam® (Absorbable surgical sponge, Upjohn) may be used dry or moistened with sterile saline to fill bony cavities, serving as a matrix for the formation of a clot. It may be soaked in penicillin solution to retard infection or in thrombin to give hemostatic action.

Thrombin, produced by Parke, Davis and Upjohn, is derived from bovine plasma The powder and diluent are packaged together but kept separate until use is required. One thousand and 5000 unit sizes are available. Because of the foreign protein content this material should only be used topically, and never injected.

Epinephrine Hydrochloride Injection, U.S.P. Adrenalin® is the trade name of epinephrine, formerly patented, of Parke, Davis. This preparation is sterile, while other forms of the substance are produced for topical use in rhinology, etc. In the 0.1 per cent solution it may be applied to the surface of surgical wounds to control capillary and arteriolar bleeding.

Neo-synephrine hydrochloride® (Phenylephrine hydrochloride, Winthrop-Stearns) is a synthetic preparation with actions similar to those of epinephrine, but stated to be less likely to produce cardiac

arrhythmias when injected. It is available in 1 per cent sterile solution.

HYPNOTICS AND SEDATIVES

The doses which are given are for sedation of adult patients. The hypnotic dose is twice the sedative dose. These drugs do not relieve pain unless given in toxic doses.

Nembutal® (Pentobarbital sodium, Abbott) is available in capsule, elixir, suppository, and injectable forms. The dose is .050 to .100 gram ($\frac{3}{4}$ to $1\frac{1}{2}$ grains). Each teaspoonful of the elixir contains .015 gram ($\frac{1}{4}$ grain) of Nembutal sodium.

Seconal® (Lilly) may be obtained in capsule, elixir, and in an injectable form for intravenous use. This is a shorter acting barbiturate than pentobarbital sodium. The dose is .050 to .100 gram ($\frac{3}{4}$ to $1\frac{1}{2}$ grains). The elixir contains $\frac{1}{3}$ grain per teaspoonful.

Phenobarbital, U.S.P. (Luminal® is the trade name of phenobarbital, Winthrop-Stearns). Oral tablets, elixir, and injectable phenobarbital sodium are available. The dose is .030 to .060 gram ($\frac{1}{2}$ to 1 grain).

Chloral hydrate, U.S.P. is a useful preparation to keep in mind for patients who are sensitive to barbiturates. The crystals are highly soluble in water. The preparation may be stored in aqueous solution and diluted with carbonated beverages or milk for administration. The dose is .300 to .500 gram (5 to 8 grains).

STIMULANTS

Caffeine sodio-benzoate, U.S.P. may be given orally or by injection. The dose is .500 gram ($7\frac{1}{2}$ grains).

Coramine® (Nikethamide, Ciba). The 25 per cent solution may be used orally or parenterally for respiratory and circulatory stimulation, in doses of 1.5 to 3 cubic centimeters, repeated as necessary.

Metrazol® (Pentamethylentrazol, Bilhuber-Knoll) is available as oral tablets and in injectable form for subcutaneous, intramuscular, or intravenous administration. It is used for respiratory and circulatory stimulation in asphyxia, barbiturate poisoning, etc. The dose is .100 gram ($1\frac{1}{2}$ grains) orally or 1 to 3 cubic centimeters ($1\frac{1}{2}$ to $4\frac{1}{2}$ grains) by injection.

Epinephrine Hydrochloride Injection, U.S.P. May be used in doses of .0005 gram ($\frac{1}{120}$ grain) to restore blood pressure in cases of shock, but hypotension returns after a short interval of time, and side effects such as cardiac arrhythmias may occur. Other preparations are now used to restore vascular tone, as a rule.

Levophed® (L-arterenol, Winthrop Stearns) may be given intravenously (4 cc. of the 1 1000 solution in 1000 cubic centimeters of normal saline) to restore blood pressure in shock and related conditions.

Merthiolate® (Lilly). The tincture and aqueous forms are both available in concentrations of 1·1000. Stains may be readily washed out.

Zephiran Chloride® (Benzalkonium chloride, refined. A mixture of high molecular, alkyl dimethylbenzyl ammonium chlorides, Winthrop-Stearns). Both tincture and aqueous forms are available in 1:1000 concentration. Zephiran is used in full 1.1000 strength for sterilization and storage of instruments. Rusting will occur unless sodium carbonate or "anti-rust" tablets are added. The solution should be changed weekly. If soap is used in cleaning instruments it must be thoroughly removed before placement in Zephiran, as the actions are antagonistic. Whenever possible, instruments should be sterilized by boiling or autoclaving. (See comments in Chapter 5 on cold sterilization, p. 121.)

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Phenobarbital, U.S.P. (Luminal® is the trade name of phenobarbital, Winthrop-Stearns). Oral tablets, elixir, and injectable phenobarbital sodium are available. The dose is .030 to .060 gram (½ to 1 grain).

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Epinephrine Hydrochloride Injection, U.S.P. May be used in doses of .0005 gram ($\frac{1}{120}$ grain) to restore blood pressure in cases of shock, but hypotension returns after a short interval of time, and side effects such as cardiac arrhythmias may occur. Other preparations are now used to restore vascular tone, as a rule.

Levophed® (L-arterenol, Winthrop Stearns) may be given intravenously (4 cc. of the 1:1000 solution in 1000 cubic centimeters of normal saline) to restore blood pressure in shock and related conditions.

Vasoxyl® (Methoxamine hydrochloride, Burroughs, Wellcome.) When injected, this substance has the ability to raise blood pressure without cerebral stimulation, tachycardia, or cardiac arrhythmias. The dose is .015 gram ($\frac{1}{4}$ grain) intramuscularly or .005 gram (grains $\frac{1}{12}$) intravenously.

Tensilon® (3-hydroxyphenyl dimethylethyl ammonium chloride, Hoffman-La Roche) is a specific curare antagonist, used to counteract the effect of muscle relaxant agents used during intravenous anesthesia. The dose is .010 gram, repeated as necessary.

SULFONAMIDES

Combinations of three sulfonamides are now produced by many manufacturers, to reduce the possibility of toxicity due to any one substance, while at the same time giving the additive therapeutic effect of the several agents. The most frequently used drugs are sulfadiazine, sulfamerazine, and sulfamethazine, .167 gram each, for a total of .500 gram per tablet. One of the above is replaced by sulfathiazole or sulfacetamide in some of the preparations. Triple sulfonamide preparations are offered by.

Abbott (Truozine®), Lederle, Lilly (Coco-sulfonamides triplex®), Merrell (Pansulfa®), Schering (Tricombisul®), Sharp and Dohme (Cremotres® triple sulfonamide suspension,) and Wyeth (Sulfose®).

All manufacturers caution that the usual adverse reactions from the component sulfonamides must be watched for such as crystalluria, skin rash, and effects of bone marrow repression. Fluids should be forced.

Gantrisin® (Sulfisoxazole, Hoffman-La Roche) is a more soluble, single sulfonamide with a wide antibacterial spectrum, according to the manufacturer. It is available as oral tablets and syrup. The dose of this and all the above mentioned preparations is 4 grams initially and 1 gram every four to six hours.

VITAMINS

Multivitamin Preparations

A. *Capsules* containing dietary supplements of the essential vitamins usually lacking during restricted food intake are marketed by Abbott (Dayamin® capsules), Lederle (Vi-Magna® capsules), Lilly (Multicebrin® gelseals), Mead, Johnson (Mixed vitamin capsules), Parke, Davis (ABDEC Kapseals®) and Upjohn (Unicap®).

B. *Liquid preparations* for patients who are unable to take capsules are produced by Abbott (Dayamin® liquid), Hoffman-La Roche (Vi-Penta drops®), Lederle (Multivitamin syrup), Lilly (Vi-Mix drops®), Parke, Davis (ABDEC drops®), Upjohn (Zymadrops®), White (Multi-Vi drops®), and Wyeth (Dapta®).

Vitamin K Preparations

A. *Hykinone®* (Menadione sodium bisulfite, Abbott) is available in oral tablet and injectable forms. It is indicated in conditions

with circulatory deficiency of prothrombin and interference with intestinal absorption of vitamin K. The dose is .0025 to .005 gram every twelve hours. As an antidote to Dicumarol overdosage .072 gram may be given.

B. *Synkayvite*® (Synthetic sodium menadiol diphosphate, Hoffman-La Roche). This preparation also contains ascorbic acid and four B-complex factors. Oral and injectable forms are available. The dose is 1 capsule three times a day orally, or .005 to .010 gram intravenously or intramuscularly as required. To counteract Dicumarol, one or more .075 gram ampuls are given, as needed.

C. *Mephyton*® (Emulsion of vitamin K_1, Merck) is available in ampul form for injection. This is the only fat-soluble preparation among those listed here. No bile salts need be given to obtain the therapeutic effect. The dose is .002 to .010 gram. For reversal of the effect of Dicumarol .050 to .150 gram are needed.

D. *Synkamin*® (Synthetic vitamin K compound, Parke, Davis) may be obtained as oral capsules or in ampuls for injection. The dose is .001 to .005 gram daily by injection, or one .004 gram capsule daily.

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15

Hospital Practice

Types of Hospitals

Hospitals vary widely as to type and size. Most private hospitals have no dental clinic, and that dentistry which is done must be performed in the facilities which are designed primarily for rendering medical care Hospitals for tuberculous and mental patients often have a well-established dental clinic with one or more full time dentists to render all types of care to the inmates. Military and Veterans Administration hospitals all have fully formed dental staffs and clinics. Hospitals associated with universities (and dental schools) usually have highly developed dental services, with emphasis on oral surgery.

Areas of Activity

1. *The Hospital Dental Clinic.* In the ideal situation, where a hospital provides space for a dental clinic, the dentist can function effectively in the manner for which he has been trained. The types of care which he can render are limited only by his skill and resourcefulness. He may be called upon to see only in-patients, or on the other hand he may be expected to attend to the needs of ambulatory out-patients as well.
2. *The Operating Room.* All hospitals have at least one operating room and an admitting or emergency room, and when the building does not contain a dental clinic, all oral surgery is done in one of these environments.

Role of the Dentist

In the hospital the dentist may be called upon to function as diagnostician, consultant, restorative dentist, or oral surgeon, but it is the last of these that will be discussed in this section.

The general practitioner who has no staff position or other definite connection with a hospital may have very few occasions when he is called upon to do professional work in a hospital. Some have had one or two experiences which have left them with no desire to return. Most unpleasant episodes are caused by a lack of familiarity with hospital procedure, and consequent embarrassment. Any dental procedure takes about three times as long to complete in a hospital as in an office or dental school clinic and no amount of foresight and planning seems to reduce this time factor to any appreciable extent.

Nonetheless, hospital dentistry can be a fully satisfying and broadening experience. In some areas of the country the care of jaw

fractures and other oral surgical conditions has been taken over by medical specialists, because the local dentists are either indifferent or are unwilling to give up the time necessary to care for these cases in the hospitals.

INDICATIONS FOR EXTRACTIONS IN THE HOSPITAL

Since the oral surgical procedure which most frequently requires the dentist to operate in the hospital is tooth extraction, the steps that must be followed in rendering this service will be described in detail. It may be necessary or desirable to extract teeth in the hospital for:



FIG 223 Oral surgery in the hospital operating room (Photo by Dr Charles J Welter)

1. Patients who are already in the hospital.
2. Patients who desire to enter the hospital for their extractions.
3. Patients requiring general anesthesia for their surgery.
4. Patients with systemic disease which makes them unsuitable for office care, such as those with blood dyscrasias, heart disease, or some crippling deformity that makes it physically difficult for them to come to an office.

PRELIMINARY ARRANGEMENTS

1. The dentist must have "privileges" in the hospital where he plans to do the work.

2. The admission must be arranged under the name of a physician who is on the staff of the hospital, and cooperation for physical examination and general medical supervision must be secured from (*a*) the family physician, (*b*) an internist, or (*c*) an interne or resident. (Note: In special situations where an understanding has been reached at the local level, patients may be admitted and discharged by the dentist himself.)

3. The date and hour of the operation must be determined and the case scheduled with the appropriate hospital authority.

4. A decision must be made as to what type of room will be suitable for the performance of the surgery.

(*a*) The emergency or treatment room is satisfactory for very brief, simple procedures, costs the patient much less, and does not require complete gowning and draping. However, fewer facilities are available here.

(*b*) The operating room provides many facilities, plenty of auxiliary assistance, and a completely aseptic routine. However, it costs the patient much more, provides many things the dentist may not need, and actually lacks many of the conveniences of a dental office.

5. The dentist must determine which items of special equipment and services are not available at the hospital, make a list of them, and be certain they are on hand when needed Examples of such items are. instruments, radiographs, suction aspirator, headlight, dental engine, surgical assistant, anesthetist, etc.

6. The bed reservation must be made.

7. Dental radiographs should be taken, processed, and mounted

8 The need for certain laboratory work should be anticipated. If this can be done prior to admission there will be a saving in time and money.

9. Accomplishment of the admission history and physical prior to admission will likewise save time and money.

10. The dentist should anticipate the amount of his own time that will be required for the actual operation and for preoperative and postoperative visits.

11. The patient should be advised of the approximate cost of hospitalization and the customs of the hospital regarding down payments, and method of payment. Virtually all hospitals require payment in full at the time of discharge. The usefulness of hospitalization insurance which the patient may have should be clarified before admission.

Duties Immediately upon Admission

1. *General Orders.* Nurses are rigidly trained to give no food, medication, or care to any patient without specific orders. Therefore, they will telephone the dentist as soon as the patient is admitted to the floor, to receive routine and special orders. The items that must be attended to are:

(*a*) Diet. When there is no contraindication, the patient should be given a "general diet" until the period of "nothing by mouth"

begins. The exact hour at which all food and fluids are to be withheld must be stated.

(*b*) Restriction or freedom of activity should be indicated by the appropriate order for "bed rest," "bathroom privileges" (BRP), or "up and about."

(*c*) Orders for oral care should be "brush teeth after every meal," "hot mouth wash every hour," or any other specific measures that are desired.

(*d*) Laboratory work should be ordered if this has not already been done. The minimum tests that are required are urinalysis, total white count, hemoglobin, and bleeding and clotting time.

(*e*) Any necessary chemotherapeutic medication should be ordered.

(*f*) Sleep producers and pain relievers should be ordered as necessary. It should be specified whether they are to be given "p.r.n." (as necessary) or at a specific time.

(*g*) The possible need for laxatives, cathartics or enemas should be considered and specific orders given.

2. *Preoperative Orders*. These are separated from the above because patients occasionally spend a day or two in the hospital before the time of surgery. When admission takes place the afternoon or evening before surgery, these orders are written at the same time as those for general care.

(*a*) "Nothing by mouth" should start at midnight in most instances.

(*b*) Morphine and atropine, or substitutes for them, should be ordered in most instances, to be given one hour before surgery. In some cases the anesthetist wishes these to be given intravenously on the operating table, or omitted entirely.

(*c*) A sedative, usually one of the barbiturates, should be given at the hour of sleep (h.s.) to insure a good night's rest.

(*d*) The hour at which the patient is to go to the operating room should be entered, for example, "To O.R. at 10:00 A.M." If the hour cannot be specified, and the case is simply to follow others in sequence, the order is written, "To O.R. on call."

3. *Visiting Patient*. The patient must be seen in person as soon as possible after admission. There is no substitute for personal contact with the individual who is to undergo surgery. Patients sometimes have complaints about their accommodations or other details, and always have questions that occur to them at this time.

4. *Rechecking of All Arrangements*. This can be done conveniently while the dentist is in the building seeing to his patient's welfare. There must be no slip ups, for a single omission may seriously detract from the success of the operation. Proper scheduling of the case should be verified at this time.

Duties the Day of Operation

1. All items on the list of special equipment or facilities must be taken to the operating room.

2. The operator must be on time—early if possible.
3. The dentist must notify his office assistant how long he will be gone.
4. The operation is performed. Every effort should be made to use the same technics that are commonly employed in the office or clinic. Some difficulty is inevitable due to the horizontal position of the patient. Improvisations cause delay and give unpredictable results.
5. Immediately after the operation the dentist must:
(*a*) Look to the patient's welfare until consciousness returns.
(*b*) Write postoperative orders.
(*c*) Dictate or write up the operation.
(*d*) Talk to relatives.
6. The patient must be seen some time the same evening. A phone call to the nurse is not sufficient.

DUTIES AFTER THE FIRST DAY

1. While many patients who have entered the hospital for removal of teeth can be discharged the following day, if the stay is prolonged the dentist must visit at least once daily, twice if the patient is at all ill or uncomfortable.
2. Each time the patient is seen the abbreviated history, physical, and laboratory review should be done. The patient should be specifically questioned about bleeding, pain, eating, drinking, fever, bowels, and general feeling of well being.
3. The orders to the nurse must be adjusted daily regarding the patient's activities, diet, antibiotics, pain relievers, sleep producers, hot packs, ice bag, mouth washes, and dressings.
4. A progress note should be entered on the chart each day, and signed.
5. When the patient is afebrile and making satisfactory progress, an order for discharge should be written.
6. At a later date, when called upon, the dentist must enter the properly worded diagnosis and name of operation on the face of the chart.

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16

The Art of Practice

Oral Surgery as an Art

If a practitioner has the right instruments and knows his oral surgical skills, yet cannot use them effectively on patients, his knowledge and training will be of no use to him.

The principles which have been described in the preceding pages represent applications of the basic sciences to the problems of clinical oral surgery. As the dentist applies his knowledge to care for the needs of his patients he is performing an art, and this skill or aptitude should be recognized for what it is. Science is knowledge of facts, particularly those relating to natural phenomena of the physical world. Art is the application of that knowledge to man's use. In the finer sense, the art of practice denotes the finesse, smoothness, timing, rhythm, insight, and understanding with which professional care is rendered.

As in all forms of well-executed art, oral surgical care of patients should be not a disjointed sequence of mechanical steps, but a well-integrated, smooth flowing series of actions which are adjusted to the patient's needs.

As an example, to illustrate the necessity for integration of surgical technic, judgment, and sympathetic concern for the patient, the recommended method of testing for anesthesia will be described.

1. Approximately two minutes after the local anesthetic has been injected the operator says, with a slow, distinct voice, "We are going to start now, very carefully and slowly at first. If at any time you would like me to stop, just raise your hand and I will do so. Do you understand?" (Note that there has been no mention of the words *pain, hurt, pressure,* or *too much pain.* This would plant the thought in the patient's mind that the dentist thinks there may be pain—a terrifying prospect! The operator should radiate confidence in his anesthetic solution and the method in which it was injected. The affirmative approach is important.)

2. When the patient indicates that he understands, the operator initiates his operation in either one of two ways:

(*a*) He places the forceps beaks lightly on the tooth and *gradually* applies pressure, watching the patient's hands out of the corner of his eye. If there is no signal to stop he gradually increases the amount of force until it is very evident that he is past the point where pain would have been felt if inadequate anesthesia were present. This observation is reassuring to the dentist, who may have had some secret doubts up to that point!

(*b*) The operator may elect to use the number 7 wax spatula as his first working instrument. In this event he should also accomplish some actual surgery right from the start, such as prying up a labial or buccal interdental papilla. It is *not* recommended that he press the instrument into the gingival crevice and ask, "Does this hurt?" or "Does that hurt too much for you to stand it?" or, ambiguously, "Do you feel this?" The reasons against such a method of testing for anesthesia should be obvious. First, it is thoughtless for the dentist to ask questions of the patient when there are instruments in the mouth. Second, the idea of probability of pain is given to the patient. Third, valuable time is consumed without the accomplishment of work.

Every patient who sits in a dental chair to have a tooth removed is frightened or apprehensive to some degree. Both mental and physical suffering combine to make many dental procedures unpleasant for the patient. The operator must care for both by his anesthetic agents, his attitude, and his spoken words. As the students say, "The anesthetic is local, supplemented with vocal"

3. The strength of the force is increased to the required amount necessary to extract the tooth. This is done with slow, resolute, purposeful movements. Most teeth can be extracted in this manner in fifteen to thirty seconds.

4. If at any time the patient raises his hand, the operator must remove fingers and forceps from the mouth and gently inquire, "Is something bothering?" Depending upon the reply he will allow further time for deepening of the anesthesia or, if some complaint other than pain was reported, he will care for the patient's need in the appropriate manner. Reinjection at the two or three minute point is equivalent to admitting that the original injection was improperly performed.

5. Assuming that the patient does not interrupt the operation and that the tooth is extracted promptly, it is laid on the table and the dentist observes whether it is intact. Upon confirming the fact to himself, he says in a calm, pleasant voice something to this effect, "That tooth is all out now. It wasn't so bad, was it? Did you feel any discomfort?" The patient's statement that there was no pain at all constitutes *the best and really the only proof* that the anesthesia was adequate for the extraction of that tooth for that patient. Both the mental and physical aspects of the apprehension have been satisfied, and when the realization comes over the patient that the ordeal is over, his mental attitude is frequently very favorable.

The use of this method of testing for anesthesia permits completion of a simple operation at the earliest possible moment after complete anesthesia has become established. It does not jeopardize the feeling of good will of patient toward dentist, for the patient has clear instructions to raise the hand to stop the operation at any time. If the hand is not raised it is evident that the patient either had no pain or preferred to endure slight discomfort in order to speed the operation to completion.

Sometimes patients cry out or squirm about but fail to raise the hand. Under such circumstances it is well to pause and repeat the instructions, adding that crying out does not help, but will simply disturb patients in the waiting room. If this behavior continues, and the patient does not listen or cooperate, the operation should be discontinued until rational conversation can be resumed. If, in spite of a highly agitated state, the patient gives no report of actual pain, heavy sedation or general anesthesia is indicated. If the patient states, upon calming down, that there was true pain, there should be no feeling of ill will if the first stimulating surgical movements were made very gradually. In some instances patients will raise the hand just to see if the dentist means what he says (!), then urge him to continue.

The Care of Children. Some of the greatest pleasures in the dentist's life come from the care of little children, because of their freshness, frankness, and ready appreciation of true sincerity. Although they are not receptive to complicated explanations, children react well to honesty and badly to deceit.

The general practitioner is more fortunate than the specialist in that the former has the opportunity to get to know the child patient through a series of appointments for routine dental care. When the need for oral surgery arises he already has the child's confidence. On the other hand the specialist must establish communication with the young patient at the first and crucial visit. When the subject is suffering from severe pain due to an acute infection the psychological problems are often complex.

Children react well to all drugs and anesthetics which are suitable for adults, providing the correct dosage is used, but their high metabolic rate often makes the estimation of the correct dosage somewhat difficult. Due to the high activity of their vital processes they often make remarkably prompt recoveries from serious illnesses. Further, since their mental processes are simpler, they tend to forget unpleasant experiences more quickly than adults.

It must be remembered that no operation should be performed upon a child without the consent of the parent or guardian, preferably written. The rule applies to all individuals who have not reached the age of twenty-one.

Personality as an Adjunct to Skill

It has been said that character is what you are and personality is what people think you are. The public judges the dentist on the outward manifestations of his personality. The "bedside manner" of the well-loved family physician is simply the embodiment of an outgoing type of personality which sublimates inner strife to present a calm, affirmative manner to those dependent upon him for assistance.

In attempting to carry off the "pillar of strength" role while caring for patients with oral surgical problems, the dentist will find that it takes considerable self restraint to remain calm and pleasant

in the presence of patients whose disposition is not of the best, due to their condition of stress. Yet it is imperative that he do so, for the patient subconsciously wants the dentist to be strong and confident, wishes to become dependent on him.

Practitioners of dentistry who are naturally of the extrovert type have no difficulty establishing and maintaining contact with the patient from the moment of first encounter; their problem is curbing discussions somewhat so that too much is not said, so that work gets done. On the other hand, the introvert type of dentist will realize, after some reflection, that he must make some willful effort to affect a role which is midway between modesty and self-confidence, if he is to achieve a satisfactory level of rapport with his clientele. It is comforting to recall the words of the great psychologist, William James on this point. He has well described the way in which one who is depressed or apathetic can forcibly alter his mood to a more desirable state by concentrating on the things that will bring about an improved state of mind. Assuming an erect posture, forcing up the corners of the mouth and otherwise employing psychomotor activity consistent with a cheerful outlook *will actually bring about the desired mental state.* By the same token, as every child knows, sadness can be brought on by frowning, and forcing the tears to come. We *feel* the way our body *acts.*

While not strictly a component of personality, the status of personal cleanliness and grooming is so closely related that it must be given some mention. Whiskers, dirty fingernails, unkempt hair, neglected clothing, all serve as *distractors* to the patient, and reduce the effectiveness of otherwise effective professional care. The same is true of the office furnishings and equipment. They should give evidence of prosperity, and be in good taste but not gaudy. All of these things help to prepare the patient for the pending surgical ordeal with a calm mental attitude which is conducive to a feeling of confidence.

Unless a dentist is a genius at remembering people's names he would do well to have an inflexible rule that the patient's record be before him on the occasion of every visit. It is a well-known fact that no word is more pleasant to the ears than one's own name. As he glances at the record the dentist sees the correct name of the patient and knows exactly what was done and said at the last visit.

While it may be a bit beneath the dignity of this discussion, a few words should be said about the human fondness for receiving samples! While this quality is particularly well developed in children, even adults feel pleased upon "getting something" they did not expect, which has some use for future needs. The child patient is delighted with a sucker, balloon, or ten-cent toy. The adult is favorably impressed by a small package of sterile sponges, a few analgesic and sedative tablets, and a postoperative instruction leaflet. It is the thoughtfulness behind the article which evokes the feeling of pleasure.

To summarize, the successful dentist must not only possess

scientific knowledge and surgical skill, he must also be a bulwark of strength to the suffering ones who come to him for aid. He must be an "adequate adult" personality in every sense of the word.

Routines and New Situations

The dentist will find that he looks forward to oral surgical cases in proportion to the degree to which he is prepared for them. Spare time can be well spent in servicing oral surgical equipment, developing wax or plaster models of oral surgical conditions for patient education, and becoming generally better prepared for this phase of the office activity.

All frequently repeated tasks should be routinized after sufficient time has passed for analysis and determination of the simplest and best way to perform the work. All office personnel should be briefed on the details of the method, and the task should then always be done *in exactly the same way* from that day forward. Examples of such chores are: chisel sharpening, cleaning and sterilization of instruments, preparation of supplies, filling of medicine bottles, processing of radiographs, etc. Many other examples of effective routines have been described throughout the preceding pages. Establishment of standard methods of work relieves office personnel of the annoyance of indecision in elementary chores, and reserves mental energy for the solving of new problems that come up during the day's work.

In spite of fixed routines for things that can be so handled, many new situations arise during every working day, which require ingenuity and resourcefulness for solution. It will be found that improvisation actually consists of making serial multiple choices, one at a time. Progress through a busy day is much like a journey over unfamiliar highways. The correct choice must be made at each of many forks in the road. The dentist must draw from his store of knowledge to solve problems by the process of mental trial and error. As he gains in experience and finds himself dealing with old familiar problems more and more, the number of trials with error becomes smaller.

In spite of a sincere desire to have things go just right, there are days when everything seems to go wrong! The office nurse may be late or absent. She may drop things or make unbelievable mistakes. The developer may be too hot, the chisels dull, and the patient unmanageable. It is often necessary to put up with inadequate working conditions temporarily. In the presence of adversity the dentist above all must hold his temper, do the best he can, and restore order from chaos. Criticism of office employees in the presence of patients is most unwise, for it undermines the confidence of the patient which has been built up with such painstaking care up to that point. Corrective discussions with office assistants should be done in private. Out of every mishap or mistake should come some lesson which will help to increase the standard of care for future cases. "We never learn by doing things right."

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OBJECTIVES OF PRACTICE

Personal Satisfaction. Every normal adult instinctively craves the approval of his fellowmen, but he also has certain standards of personal accomplishment that are very important to his feeling of self esteem. The accumulated experiences of life help to form the ideals which decide one's conduct in many specific situations. For example, the conscientious dentist unhesitatingly accepts the challenge of a puzzling diagnostic problem—not because of any immediate thought of financial gain, but because his intellect is intrigued by the possibility that he may be able to solve the problem and relieve the patient of his symptoms. His primary, and sometimes only, rewards are personal satisfaction and the feeling that he has acted in accordance with his own self-established ideals.

Service. One of the reasons that men and women of high type are drawn into the healing professions is the desire to be integrated with society in some way which will enable them to be of service to others. This willingness to serve humanity is recognized by society in the form of certain privileges and immunities which the community gives to all professional individuals. This is the outstanding feature which distinguishes a profession from a trade or business.

Remuneration. It is entirely fitting for this objective of practice to be given proper emphasis. The dentist's only source of income is in the form of fees for his professional services. It would be unthinkable that three thousand talented young people would enter dental schools annually and apply their energies for four years if they did not hope to achieve financial security and even a bit of affluence. Society recognizes this right too, and freely admits that even as the laborer is worthy of his hire, the skilled practitioner of a healing art is entitled to his fee.

It has long been recognized that something wholesome happens to the patient when he gives his fee for services rendered. A tacit understanding flows between patient and dentist that the care has been well rendered. Both dentist and patient feel they have gained by the exchange of money for service. Paying for his own dental care or that of his family engenders a feeling of self respect in the patient. This is well recognized in charity clinics, where it is usually arranged for the patient to "pay what he can."

Fees for dental care, more particularly oral surgery, should be in keeping with the quality of the service rendered. The proper sequence is to first give the highest possible quality of service without thought of cost, then fit the fee to the good care which has been rendered. This general rule tends to keep the dentist's interest high, for he is being adequately compensated for his extra effort. It is fatal to scale down the quality of service to a low fee which the dentist feels the patient would pay without objection. At the same time it must be recognized that great service may be done to a patient by the rendition of some simple professional act, and the fee should be kept low in proportion to the time and effort expended.

When the dentist is plagued by some complication following his own treatment such questions as whether to give or withhold antibiotics, whether to call for consultation, or whether to place the patient in the hospital should be answered without thought of cost. The question of expense can be settled better when the patient is recovering from his difficulties. In the main, these expenses should be borne by the patient as just and fair obligations.

The Professional Life

Balanced Activity. To do his best work in oral surgery the dentist must keep in good health, physically and mentally. It is entirely proper for him to have one or more forms of recreation that keep him fit, give him the satisfaction derived from some form of sport, and which purge his mind of the cares of his precise and exacting calling.

He should yield to the temptation to engage in light reading for diversion and enjoyment but should maintain at least some contact with the literature of his profession. Many dentists find that even ten minutes a day devoted to browsing through a dental journal or book will give them the needed stimulation for solution of some problem or reawaken their interest in some nearly forgotten phase of their art.

When proximity to a teaching institution or charity clinic makes it possible, the dentist may find that he receives more than he gives by engaging in the activity of these environments which is so different from that of his own private office. He may receive the impetus to write and publish as a result of the contact with other clinicians, teachers, and research workers.

All dentists are now within reach of some university dental school where postgraduate courses of a few days or a few weeks are being offered. Recent developments in the various dental fields, including oral surgery, are readily learned and countless other intangible benefits are gained by attendance at these refresher courses.

The satisfaction of teaching may be derived, at least to some extent, by the training of office assistants and attendants or of a younger dentist who may be added as a partner or associate. The dentist should not be so naive as to underrate his own value as a teacher, for his total knowledge and skill are the product not only of his own talents, but also the wisdom and experience of all who have helped to make him what he is.

Privileges and Immunities. As he reflects upon his lot, the dentist should be grateful for many things that are his as a heritage from those who have gone before. The high standard of dental (and oral surgical) practice today is the result of idealism of men who have plodded down the same road ahead of us. Asepsis, *x*-rays, good instruments, effective technics—all these things are freely available because of the unselfish contributions of dental and surgical pioneers.

Society has reacted to these good works by requiring, through its laws, that the dentist exercise *only ordinary care* in rendering his

services. While the phrase may sound somewhat degrading to a sensitive, idealistic practitioner of dental art, this legal statement has released many a competent dentist from some awkward or dangerous situation which appeared circumstantially bad but in which he was entirely innocent of malpractice. In a sense it would be impossible to secure people to practice dentistry and to take the countless risks that arise if this blanket immunity against apparent mistakes were not on the statutes.

Responsibilities. The professional life is not without its demands and requirements. Unprofessional conduct, inebriety while caring for patients, immoral or actually illegal conduct bring swift reprisals from society, the dental associations, or the state board of dental examiners. The dentist should be familiar with the law as it applies to his calling. Although it is not generally known, a dentist is under no obligation to assume care of a patient if he does not wish to. However, once treatment has been started he is bound to continue until completion of the case or severance by mutual agreement. Although a dentist may not "abandon" a patient, he is absolved of further responsibility if the patient abandons him, *i.e.* breaks the contract for treatment without the dentist's consent or against his advice.

Ethics. The temptation will often be great to speak with discredit about some colleague in the community. If nothing good can be honestly said, silence should be maintained. Derogatory remarks have a way of getting back to the individual to whom they pertain, usually in exaggerated form.

The details of professional care of all patients must be kept in strictest confidence.

Fee splitting in any form must be strictly avoided. The practice degrades dentistry to the level of merchandising and betrays the trust given by society that the professional man holds the interests of his patient above desire for personal gain. Proof of division of fees is grounds for expulsion from the dental association.

Referral

Even though the general practitioner of dentistry is well trained and set up to do oral surgery, there will be occasions when he will wish to refer a patient to an oral surgeon. The comments given below apply, for the most part, to referral to a family physician, internist, or other medical specialist as well.

There are right and wrong ways to refer a patient. The specialist should be selected on his proven ability, wisdom, and superior skill, achieved by years of experience, preceptorship, or formal training. It is an injustice to a patient to send him to a man chosen by lodge or fraternal affiliation alone. The patient should be told frankly that this is the best man known to you for the given difficulty. It is a weak referral indeed which consists simply of a list of names of men in the city who limit their practice. The referral should be specific as to man, day, and hour.

It is more satisfactory to select the most able man in his community, then stay with him. He is in a much better position to render the service as desired if he is familiar with the individual requirements of the dentist who is to make the dental replacement for teeth to be removed. The oral surgeon is more likely to respond cheerfully to unusual requests such as Sunday calls, broken needles, roots in antrum, etc., if a cordial relationship has been previously established. He can, indeed, be a friend in need.

No effort should be made by the referring dentist to arrange the specialty fee. It should be known in advance that the man to whom the patient is being sent is fair in this regard. The specialist, in turn, will respond warmly to a courteous and dignified approach. He will be able to give the very best he has if the patient is sent to him full of confidence. He will do his work well, follow the patient conscientiously until healing is established, then, with complimentary words about the referring dentist and the good restorations seen in the patient's mouth, send him back to the general practitioner full of renewed good feeling. His fee will be fair and just compensation for services rendered.

It can hardly be expected that the oral surgeon will have warm regard for the dentist in general practice who only calls him when in difficulty—at twelve or five o'clock—or whose patients only come indirectly by referral from other patients.

Many good patients have been lost to dentists who delayed too long in calling for consultation, or who attempted some surgical task far beyond their ability. There is plenty of work for all—general practitioner and qualified oral surgeon—and ample place for both. One of the highest services the dentist can render his patient is a direct referral to other hands, when his experience and judgment lead him to believe this is the best course to follow.

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